The Development of a Framework for Green Information Technology Implementation in South African Organisations

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DECLARATION OF ORIGINALITY

I, Tlhalefo Petterson Moyo, declare that the thesis titled, "The Development of a Framework for Green Information Technology in South African Organisations", submitted for the degree of Doctor of Philosophy at North West University, has not been previously submitted by me for a degree at this or any other University. This is my own work in design and execution and all materials contained herein have been duly acknowledged.

Tlhalefo Petterson Moyo

CERTIFICATE OF ACCEPTANCE FOR EXAMINATION

The Thesis, entitled “The Development of a Framework for Green Information Technology in South African Organisations”, written by Tlhalefo Petterson Moyo (student number 20951671), is hereby recommended for acceptance for examination.

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DEDICATION

This work is dedicated to my late father, James Moyo, and my mother, Lenah Moyo, for their hard labour in tough and tribulation times in ensuring that I get education and become a better person. I sincerely honour and value their efforts.

ABSTRACT

This study was primarily an empirical investigation in the field of Information Technology (IT) on how Green IT is implemented by South African organisations. The relative lack of Green IT framework in ensuring succesful Green IT implementation for South African organisations was the primary impetus of this study, which advanced this important, but neglected area of Green IT. The study highlighted the pitfalls of Green IT implementation. This study adopted a realism problem solving approach using an empirical solution to find answers within the field of Green IT implementation in South African organisations. The study focused on the development of Green IT framework for South African organisations.

Society's reliance on Information and Technology (IT) has increased tremendously over the years. Unfortunately, the growth of an IT sector is contributing to climate change and raising the cost of energy. In reality, IT consumes large amounts of electricity and consequently placing a burden on electric grids. Furthermore, disposed electronic equipment (e-Waste) contains hazardous materials that are unsafe to the enviroment that cause the release of greenhouse gas (GHG) emissions in the atmosphere and contribute to the phenomenon global warming and climate change and environmental degradation. These environmental degradation and climate change have become a challenge for society. Previous studies highlight that IT industry is accountable for 3% of GHG emission which is approximately equivalent to the aviation industry because of its rate of energy consumption, and projected to increase by 6% during 2020. In the South African context, the highest contributor to GHG emission is primarily the energy sector which contributes about 85% to the total GHG emission, followed by Industrial process and Product use estimated at about 8%, Agriculture, Forestry and other Land Uses projected at 4% and Waste contributing estimated at about 3%. Therefore, action is required to halt the loss of biodiversity in order to tackle climate change for sustainability of the planet ecosystems and survivability of mankind. As a result, organisations are conscientous about going green but they are not sure how to go about it. Green IT holds promise for addressing the broader environmental and health issues in organisations. However, the impact of Green IT in creating a sustainable environment is unknown.

Previous research reveals that IT operations inherently have negative effect on the environment in the sense that they consume large amounts of electricity and the disposal of IT equipment causes the release of greenhouse gas emissions and contributes to climate change. Nevertheless, little research has been done to examine the potential of Green IT.

In order to address this research problem, the objective of the research was to develop Green IT framework. The framework is grounded in investigating the depletion of natural resources that are caused by IT activities, causing rise in energy consumption and cost in order to protect the health and wellbeing of society thereby ensuring corporate social responsibility and environmental sustainability. In this regard, an in-depth qualitative research methodology was undertaken through semi-structured interviews to gather data in order for South African organisations to implement Green IT effectively.

The research made an original contribution to the body of knowledge that has not been made before which is based on primary data collected from South African companies. The study unveiled and filled the growing gap of Green IT implementation by developing a new chain of thought. This was done by creating a Green IT framework and a process flow for Green IT implementation. This Green IT framework, in conjunction with the process flow for Green IT implementation, will provide business with enormous benefits such as reduction in energy and business cost of about 30% that will translate into financial returns, environmental protection, human health and wellbeing protection and ensuring corporate social responsibility.

The findings demonstrate the responsible approach and practices that can be used by organisations to achieve environmental sustainability. The results of the study exposed a research gap on ecological issues, e-waste management, energy consumption and Green IT strategy. The study provided practical guidelines that will assist the organisations to take responsibility for their actions and improve their environmental footprint by becoming green. Furthermore, the evidence from the study revealed that should Green IT be implemented properly, organisations will increase their bottom lines with millions of rands.

Key words (in alphabetical order):

Environmental sustainability, E-Waste, Green Computing, Green ICT, Green IT and Green technologies.

ABBREVIATIONS

CA	Correspondence Analysis
E	Electronic
EPEAT	Electronic Product Environmental Assessment Tool
GHG	Green house gases
ICT	Information communication and technology
IEEE	Institute of Electrical and Electrronics Engineers
IM	Instant messaging
ISO	International Organisation for Standardisation
IT	Information Technology
OECD	Organisations for Economic Co-operation and Development
PC	Personal computer
RoHS	Restrictions on hazardous substance
SPSS	Statistical Package for the Social Sciences
UNEP	United Nations Environmental Programme
UPS	Uninterruptible power supply
WEEE	Waste Electrical and Electronic Equipment

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CHAPTER 1: OVERVIEW OF THE STUDY

1.1 INTRODUCTION

In this chapter the researcher provides an introduction to the research project and the proposed research design. This study was primarily an empirical investigation in the field of Information Technology (IT) on how Green IT is implemented by South African organisations. The relative lack of Green IT framework in ensuring succesful implementation of Green IT for South African organisations is the primary impetus of this study, which advances this important, but neglected area of Green IT.

The research study follows a problem-solving approach to assess the implementation of Green IT in South African organisations. It thus helped not only to fill gaps identified in the research literature but also to offer recommendations to organisations for succesful Green IT implementation. In principle, the problems that form the basis of the problem-solving research relate to lack of understanding of what problems are affecting the Green IT implementation to find the solution to the problems. Therefore, problem based research is of an epistemic nature. This research utilises the realism as philosophical approach. Preliminary research reviewed in section 1.4 shows that there are gaps in Green IT implementation in South African organisations. The intention was to conduct a qualitative research through interviews.

Society’s reliance on Information and Technology (IT) has increased tremedously over the years. Unfortunately, the growth of an IT sector is contributing to increased human impact such as pollution, increased energy consumption and electronic waste that negatively affects the environment resulting in the phenomenon climate change, and challenges the survival of the present and future generation (Molla, 2009). It is acknowledged that if humans do not decrease the level of toxic waste, such as carbon, nitrogen and sulphur oxide, released into the air, the earth may no longer be a sustainable living environment for any creature (Chow and Chen, 2009:136). Empirical evidence indicates that organisations have been influenced by markert forces, legislation and ethical issues to minimise the harmful impact on the environment. Conversely, to tackle the impact on the environment, society and business need to find ways to reduce the impact on the environment in order to achieve the ultimate goal of environmental sustainability (Du Preez and Botha, 2010:1).

The rising cost of energy is posing challenges for sustinability of the global digital economy due to climate change. The essence of IT is gradually playing a serious role in altering and producing commercial opportunities, since technology is likely to create sustainable businesses and societies with grim and green economies. Therefore, the concern regarding the increase in climate change has been unprecedented, and requires solutions for environmental sustainability (Uddin and Rahman , 2012:4079-4084). In this regard, Green IT plays a pivotal role because it is intended to minimise the negative impact of IT operations on the environment by designing, manufacturing, operating and disposing of computers and computer related products in an environmentally friendly manner (Murugesan , 2008:25-26).

The general overview of this chapter is to provide a background for the thesis by clarifying what the study was concerned about, to whom it is applicable, where it took place, how it was conducted, including the reason of why it was conducted. Subsequent to this introduction, the glossary of terms, background and context of the study is clarified, the problem statement is specified and the research objectives are presented. Then, the importance/significance of the study is demonstrated, research design and methodology, limitations of the study are revealed, the problems and the result that can be expected of the research are discussed, the research layout is justified. In the ultimate, the research becomes complete with the presentation of a chapter summary.

To search for relevant literature keywords: Green ICT, Green IT, Green Computing, Environmental sustainability, E-Waste, Green technologies in terms of definitions and theories on Green IT to search in the following search engines – Nexus, Elsevier, SA Publications, ask.com, Emerald, EBSCO, Sabinet, Science Direct and Google Scholar.

The following section discusses the background and context, problem statement, research objectives, literature review, research design and methodolgy and the expected result of the study.

1.2 GLOSSARY OF TERMS

In this study the following definitions are briefly explained to provide in depth knowledge and understanding of Green IT in context. The key concepts are derived from academic journals and articles on the subject of Green IT.

Carbon footprint refers to the measure of the impact that organizational activities have on the environment, especially greenhouse gas (GHG), which contributes to climate change and relates to GHG produced daily through burning fossil fuel for electricity, heating and transportation (Hogan, 2011:20). In short, carbon footprint means to "measure the amount of GHG, measured in units of carbon dioxide that are produced by human activities" (Sinha, 2011).

Climate change: The United Nations Framework Agreement on Climate Change (2006) refers to climate change as weather change that directly or indirectly results from human activities and natural variation (Whitmarsh, 2009:404).

Corporate social responsibility refers to "the continuing commitment by business to behave ethically and contribute to economic development while improving the quality of life of the workforce and their families, as well as of the local community and society at large" (Sinha , 2011).

Data centre refers to the cooling and power delivery equipments, servers and storage to store, process, and exchange of digital data and information to business amenities containing large IT infrastructure platform (Uddin and Rahman, 2012:4078). In contrast, Hogan (2011:20) provides a different version of defining data centres and refers to them as facilities that are used to keep computer systems and related components, including out of work or backup power supplies, redundant data communication connections and environmental controls and security strategies (Uddin and Rahman, 2012:4083).

Eco-efficiency refers to a business's capability to provide competitively priced goods and services while gradually reducing natural impacts (Molla, 2009). Environmental impact is the extent to which an organisation's business process, actions and operations are positively or negatively affecting the natural environment (Jenkin, Webster and McShane, 2011:19).

Energy efficiency means the utilization of technology that needs less energy in order to achieve the same function (Uddin and Rahman, 2012:4083).

Environmental Sustainability is “the capability of one or more units, either individually or collectively, to exist and flourish for lengthy time frames, in such a way that the existence and thriving of other collectivities of units is permitted at associated levels and in connected systems. It often refers to meeting the needs of the current generations without jeopardising the ability of upcoming generations to meet their needs (Molla, 2009:1). Jenkin, Webster and McShane (2011:19) highlight environmental sustainability as the growth that meets the need and goals of present without compromising the ability to future generations to meet their own needs .

Electronic waste (e-Waste) refers to numerous forms of electrical and electronic equipment that are old and have stopped to be of value to their owners, including unwanted computers and office electronic equipment (Bandyopadhyay, 2008:1507; Begum, 2013:47; Shagun, Kush and Arora, 2013:490; Widmer et al., 2005:438). Waste Electrical and Electronic Equipment (WEEE) refers to any equipment that is reliant on electric currents or electromagnetic fields in order to function appropriately including equipment for the generation, transfer and measurement of current and fields with voltage ratings not exceeding 1000 volts (Onwughara et al., 2010:290). E-Waste is a general term covering various forms of electrical and electronic equipment that are old, end of life electronic appliances and have stopped to be of any worth to their owners (Bandyopadhyay, 2008:1507).

Green Computing is the study and practice of using computing possessions efficiently and that the primary objective is to reduce the contaminations of environment (Chow and Chen, 2009:136). Childs (2008:1) is in agreement that it is the study and practice of using computing resources proficiently .

Green economy is defined by United Nations Environmental Programme (2011) as an economy that results in enhanced human well-being and social fairness, while substantially decreasing environmental perils and environmental shortages.

Green IT refers to the ecologically sound IT . It’s the study and practice of designing , manufacturing, using and disposing of computers, servers and associated subsystems such as monitors, printers, storage devices, and networking and communications system- efficiently and effectively with slight or no impact on the environment (Murugesan , 2008:25-26). Jenkin, Webster and McShane (2011:18) refer to Green IT as Information Technology and system initiatives and programmmes that seek to address a sustainable environment. Molla (2009) futher explains that Green IT is an organisation’s capability to scientifically apply environmental sustainability principles (such as pollution prevention, product stewardship, use of clean technologies) to the design, production, sourcing, use and disposal of the IT technical infrastructure as well as within the human and managerial components of the IT setup.

IT lifecycle refers to the demanding consideration or stewardship from the cradle to the grave (beginning to end) of things which the organisation could reasonably contemplate having impact or choice, which may include the management of the full life cycle of the business products and would definitely include bearing in mind the life cycle of the IT equipment being procured (Mingay, 2007).

Sustainable development refers to the consumption of goods and services that meet essential needs and the quality of life without endangering the ability of forthcoming generations to realize their own needs (Chong et al., 2010:85; Elliot, 2013:270; Jenkin, Webster and Mcshane, 2011:19; Mingay, 2007; Nnorom and Osibanjo, 2008:849; Trimi and Park, 2013:364). However, Borel-Saladin and Turok (2013:211), view the definition contrarily and refer to sustainable development as economic prosperity of reducing poverty and inequality in order to accomplish environmental progress.

1.3 BACKGROUND AND CONTEXT

The concept of Green IT emerged in 1992 when the United States Environmental Protection Agency launched the Energy Star programme. The intention of this launch was to ensure a voluntary labelling programme to segregate computers, monitors and equipment based on their energy effeciency. Most significantly, the main purpose of this launch was to help organisations save money and reduce on greenhouse gas (GHG) emissions through the identification of products that offer greater energy effeciency. It is for this reason that Green IT is receiving considerable interest from organisations that realised that going green is in their best interest to curb the negative environmental impact (Nayab, 2011).

Green IT adoption plays an important role in organisations because it encourages new ways of reducing atmospheric pollution, implementing higher effeciency and alternative power generation systems, discovering different data servers, manufacturing recyclable computers and the use of less hazardous materials in technological revolution. In a nutshell, Green IT adoption offers economically viable solutions for organisations that conserve energy and protect the environment (Murugesan, 2013).

The highest contributor to GHG emission in South Africa is the Energy sector which contributes about 85% to the total GHG emission, followed by Industrial process and Product use estimated at about 8%, Agriculture, Forestry and other Land Uses projected at 4% and Waste contributing estimated at about 3%. This has resulted in South Africa being counted amongst the highest emitter of GHG emissions. Notably, the Energy sector includes the GHG emissions that are emmited from oil and natural gas thereby contributing to the phenomenon climate change (Botes, 2012).

Previous studies also highlight that IT industry is accountable for 3% of global emissions which is approximately equivalent to the aviation industry because of its rate of energy consumption, and projected to increase by 6% during 2020. Should the existing trend continue consistently it will grow more than predicted by 2020, thus posing unmanageable worries and creating a new climate of uncertainity (Gartner, 2008). As a result, organisations are starting to realise the benefits of using Green technologies in order to reduce carbon footprint and improving their business performance (Murugesan, 2013).

The concerns surrounding environmental sustainability have come to the attention of society and the corporate world, and the agreement among the scientifc community is that the rise in green house gases in the atmosphere is the result of human activity, and business needs to find ways to lessen their impact on the environment in order to attain the eventual goal of sustainability (Packhard and Reinhardt, 2007). According to Molla (2009:1), the role of IT in resolving eco-sustainability issues (usually referred to as Green IT) is an under researched area. Therefore, the long term effects of pollution over the previous decade have seen several businesses grasping ways to enhance their environmental footprint and taking responsibility for their actions. In line with the statement above, Mattern, Staake and Weiss (2010:1) concur that the rising challenges of IT include the contribution of technology to optimal use of renewal energy and helping estabish new energy services and solutions to sustainable development. Similarly, Hanne (2011:426) is also in agreement that the reduction of greenhouse gas emission is a benefit for energy saving through the implementation of Green IT.

The notion of going green is also supported by Talebi and Way (2009:1) who believe that pollution foot print and reduction of energy implies going “Green”, which designates things that are good for the environment, generally health-giving and economically sensible. Furthermore, Talebi and Way state that the development and promotion techniques for improved energy efficiency is the lessening of pollution and energy trail of computers. There is strong evidence that suggests that the minimisation of the environmental footprint implies the use of cleaner technologies, as business and society widely accept technology to create business sustainability (Molla and Abareshi, 2012:92). In the same way, Hanne (2011:424) believes that energy effeciency, ecologically friendly products and proper disposal of IT end of life is mainly Green IT which aims at reducing the ecological impact of IT use. As a result, IT professionals are also turning to Green IT, in order to advance IT activities in a sustainable manner.

Going green implies seeking a resolution to reduce the overall energy consumption due to developing technology of corporations. Power grids have forced technology companies to design and manufacture energy efficient products, that is technology indispensable to enterprises and consumer demand. As such, moving towards Green IT implementation has the potential to conserve energy and protect the environment leading to substantial saving of money for the organisations (Albertson , 2008:1).

1.4 PROBLEM STATEMENT

The impact of Green IT implementation in creating a sustainable environment is presently unknown. There is evidence that suggests that IT operations inherently have negative effect on the environment in the sense that they consume large amount of electricity and the disposal of IT equipment (e-Waste) contains hazardous materials that are unsafe to the enviroment that causes the release of GHG emissions in the atmosphere and contributes to global warming and climate change. Bose and Luo (2011:1) argue that the emergence of Green IT has increased interest in recent years as an emerging phenomenon which has turned into the catalyst. Furthermore, they indicate that Green IT holds promise for addressing the wider environmental and health issues in organisations. Nevertheless, little research has been done to examine the potential of Green IT. In view of this statement, organisations are painstaking about being green but they are not certain how to go about it (Jenkin, Webster and McShane, 2011:34; Bose and Luo, 2011:3). In contrast, resistance to change, apathy and competing priorities have become universal problems for Green IT adoption **(**Hilty and Lohnmann, 2011:12). Gartner (2008) indicates that despite the Green IT having existed for several years and beneficial for organisations it has not been adopted by most organisations.

The emissions of GHG from various industries are rising fast and the emissions from IT are growing faster. These GHG emissions cause heat to be trapped in the atmosphere and some to escape back into space reulting in global warming and climate change. Therefore, the reduction of carbon footprints has to be addressed in order to enable developments in computing system (Uddin and Rahman, 2012:4080-4084). Traditionally, computers and other IT infrastructure consume huge amounts of electricity, placing a load on electric networks and contributing to GHG emissions (Bandyopadhyay, 2008:1507). In a similar way, Hanne (2011:424-427) pointed out that IT increases energy consumption and causes GHG emission that is likely to cause damaging consequences to the environment through pollution of the air, water and soil, extensive killing of animals and destroying plants and increase of ultraviolet rays due to depletion of the ozone layer and disposal of e-Waste having a huge environmental impact. As a result, Green IT is imperative as a response to environmental issues connected to the use of IT, which is mainly about energy consumption, use of poisonous substances and e-Waste.

Environmental problems have become international drawing attention to IT, and causing potentially disastrous consequences. Businesses and governments attempt to balance growth with environmental hazards using IT in advanced ways to address ecological problems (Murugesan, 2010:4). Molla and Abareshi (2012:92) assert that the influence of IT on the natural environment is the undesirable environmental effect of IT production, use, and disposal. Therefore, the underpinning environmental problems have health impact, and the health impact of climate change includes: the effects of extreme temperatures particularly heat waves, the physical and mental effects of flooding, and exposure to higher levels of ultraviolet, occurrence of new illnesses and permanent inhibition of the growth of certain plants essential for human survival (Childs, 2008:1).

Waste is becoming a worry in society as a result of the toxicity of some of the substances. This toxicity comes from lead, mercury, cadmium and a multitude of other substances. The swift technology change attached with low initial cost has resulted in the growth of electrical and electronic products and, at the same time, these occurrences have produced the fast development of e-Waste after their end of life (Bandyopadhyay, 2008:1507). In view of the above concern, Hanne (2011:424-427) supports the notion that when IT devices become e-Waste they pose health and environmental hazard because electrical and electronic equipment contains toxic substances, such as lead, mercury, cadmium and polybrominated flame. Furthermore, the life span of IT piecess of equipment is declining while e-Waste is escalating.

The toxic materials used in the production, use and disposal of computers, result in adverse side effects of the computing life cycle, eventually resulting in pollution (Talebi and Way, 2009:1-2). Berthon, Crittenden, Desautels and Pitt (2010:17) concur with the others that the disposal of IT equipment has become an ecological and health problem due to toxic material which is destructive to many forms of life notwithstanding the promise of clean technology. In the same vein, Murugesan (2010:4) asserts that the manufacturing of computers and their numerous electronic and non- electronic components consume electricity and the raw materials produce hazardous waste which contributes to the environmental and health impact. Furthermore, the disposal of IT equipment presents environmental challenges. In reality, IT contributes to environmental and health problems, and IT hardware is likely to cause serious environmental problems, both during production and its disposal. Hence, society is obliged to reduce or eradicate the environmental and health impact of IT to create a sustainable environment (Bandyopadhyay, 2008:1507).

The discarded old computers and other electronic hardware contain toxic materials that consequently pollute the earth and contaminate water (Murugesan, 2010:4). Similarly, Bandyopadhyay (2008:1507) shares the same sentiment that the management and disposal of e-Waste has become a concern. Therefore, there is an increasing pressure to make IT environmentally friendly. It is acknowleddged that the changes in IT consumption and the rapid improvement of technology have enlarged the variety and difficulty of electrical and electronic products. Consequently, waste has become a challenge for organisations leading to increase in environmental footprint, and high volumes of waste generation (Bandyopadhyay, 2008:1507). Typically, each phase of the IT life cycle from manufacturing to usage and disposal poses ecological problems, thus negatively impacting eco-sustainability (Molla and Abareshi, 2012:92). In view of this concern, IT is both an answer and a problem for environmental sustainability, and there is a need to reverse the process of environmental deprivation and move towards sustainable business practice (Murugesan, 2010:4).

The earth has existed for perhaps 4.5 billion years, but in the past 30 years, one third of the earth's natural resources have been consumed. Hence, the reduction of energy consumption is needed as the pace of energy consumption is not sustainable from a practical perspective (Talebi and Way, 2009:1-2). Therefore, the mounting sense of urgency by the citizens has galvanised businesses to adress the energy crisis (Bose and Luo, 2011:1). The total electrical energy consumption by data centres, servers and computers is globally increasing leading to increase in energy consumption resulting in increased greenhouse gas emissions, as electricity is generated by burning coal, oil or gas (Murugesan, 2010:4). In view of literature, the cumulative use of IT devices (laptop, mobile phones, etc) and their short life span have caused energy consumption for IT to be significantly high (Hanne, 2011:424-427). In this regard, Talebi and Way (2009:1-2) provide an explanation by saying that the increase in computer energy consumption has led to increases in pollution and related side effects, due to population increase that consequently resulted in energy consumption. Therefore, the extensive use of technology means that computer power consumption is a subject that has created an alarm.

The advancement of IT based business and social practices have transformed IT into playing roles in converting and creating economic prospects. On the other hand, there is increasing cost of energy posing challenges to the sustainability of the universal digital economy resulting in climate change (Molla, 2009:1). Talebi and Way (2009:1-2) affirm that the sensitivity to an interest in Green Computing is high due to the growing cost of energy, reduction of natural resources and increasing concern for the environment by the general population. Hanne (2011:424-427) states the Green IT as including all practices that aim at reducing the ecological impact of IT use, and is primarily about energy effeciency, ecologically friendly products and disposal of IT end of life. IT plays a role in supporting the shifts within energy sector to conserve energy towards a more sustainable generation of electricity, through optimising the performance of energy using systems to conserve energy since IT consumes energy (Mattern, Staake and Weiss, 2010:1). Bandyopadhyay (2008:1507) affirms that the improvement of energy efficiency through the lowering of green house gas emissions is the benefit of Green IT.

It is no secret that the environmental movement has grasped mass acceptance, as leading publications across the world have put environmental issues on their covers in an effort to raise awareness. Therefore, the green movement has become a topic of conversation for environmentally friendly technologies to sustainable economic activity, through ensuring a secure energy supply, preservation and protection of the environment (Uddin and Rahman, 2012:4080-4084).

The general problem

IT is contributing to environmental problems because it consumes large amounts of electricity; disposed electronic equipment (e-Waste) contains toxic substances and results in greenhouse and gas emissions contributing to the phenomenon of climate change.

Sub problems

The researcher applied the conceptual matrix framework adopted from Klopper and Lubbe (2011) to state the alignment of the research problem and research questions in ensuring that the minor/secondary problems that were identified in the problem definitions were correctly associated with the research questions, and to secure viable empirical results in order to present a concept-centric than an author literature review. It is acknowledged by Klopper and Lubbe (2011) that all problem based research commence with ignorance. The underlying reasons being that conducting research about known subjects is similar to wasting a great deal of effort in creating something that already exists. Thus, organising literature concept centred on a comparative matrix is intended to protect the researcher against ignorant assumptions about the research theme at a stage of lack of knowledge about the topic under investigation. In this regard, a well-designed research project is required to provide a powerful, integrated research methodology and analysis to achieve traction, coherence, progression and closure in problem-solution-oriented research.

Table 1.1: The problem-research question alignment matrix for solving the problem of Green IT, adapted from Klopper and Lubbe (2011)

General Problem	Sub Problems	Research Questions
IT is contributing to environmental problems because it consumes large amounts of electricity; disposed electronic equipment (e-Waste) contains toxic substances and results in greenhouse and gas emissions contributing to the phenomenon climate change.	1. Energy consumption and pollution footprint cause side effects to the environment and health.	1. What methods of technology can be used to reduce pollution and contribute to the optimal use of renewable energy?
	2. IT has a negative impact on the environment and is a problem for environmental sustainability.	2. What strategies can be used to help IT contribute to environmental solutions?
	3. Production and disposal IT product is harmful to the environment.	3. What approach can be used in the design, production, operation and disposal of IT products in a manner that is not harmful to the environment?
	4. The cost of energy is posing challenges to the sustainability of the global digital economy.	4. What method can be used to reduce the energy consumption as a result of green technology?
	5. Organisations are socially and ethically required to minimise impact of IT	5. What criteria impact on adopting Green IT towards creating a sustainable environment?
	6. The growth of IT sector occurs at the expense of the environment.	6. What sources can be used to determine the impact of adoption of strategic Green IT towards creating a sustainable environment?
	7 IT equipment consumes large amounts of electricity, and this results in significant carbon being released into the atmosphere.	7. What method and strategies can be implemented to reduce the environmental impact of IT use?

There is yet an empirical research to be conducted in South Africa that could reveal how much percent of South African organisations consider Corporate Social Responsibility and reputation as a main reason for enforcing a Green IT implementation. The present study formulates/develops Green IT framework and strategy for environmental and health protection, thereby increasing awareness on Corporate Social Responsibility and the importance of implementing Green IT for business sustainability within South African organisations.

1.5 RESEARCH OBJECTIVES

The aim of this study was to demonstrate that the results of Green IT, if not adopted leads to escalating cost of energy, depletion of natural resources and increase in concern for the environment by the general population. The objectives of the study are to:

- Provide contextual background on Green IT. The intention was to provide detailed information of the Green IT concept.
- Determine the impact of IT related products on the Environment and Health. This was intended to provide a better understanding of how IT products are impacting the environment.
- Describe the development and implementation of Green IT into business strategic plans. This was intended to provide a detailed account on how Green IT implementation can provide direction for organisations in setting and achieving strategic objectives.
- Critically evaluate the approach to Green IT. This was intended to provide a direction on the approach that can be utilised by organisations for ensuring successful Green IT implementation and provide value to businesses.
- Determine measures that can be used by organisations to implement Green IT and create a sustainable environment. This was intended to provide measures that the organisations can use to resolve Green IT implementation problems.
- Develop a framework for Green IT implementation. This was intended to provide guidance for successful implementation of Green IT in order to promote good governance and thereby creating value for organisations.

1.6 IMPORTANCE / SIGNIFICANCE OF THE STUDY

Green IT implementation has the potential to conserve energy of IT processes and improving the utilisation of resources, reduce GHG emissions and improve environmental sustainability. This can be realised if Green IT is properly implemented across the organisations. This study will, hopefully, unveil and fill the growing gap of Green IT implementation within organisations, and aims at developing a new chain of thought to develop a framework that will help business to strategically plan for proper Green IT implementation and create a sustainable environment.

This study sheds light on the possible solutions for succesful Green IT implementation within South African organisations. In this regard, the researcher believes that the study makes a contribution to identify and provide remedial action on the challenges relating to managing carbon emission through IT technologies and ensuring business value without compromising the environment, implementing sound and effective methods of technology to reduce/minimise/eliminate sensitive materials of IT products that impact the environment, introducing new energy efficient and alternative technologies to reduce operational cost for business and preserving the environment. Furthermore, implementing effective waste management systems, developing measures that seek to ensure compliance with relevant environmental laws and regulations to address environmental issues, and approaches that can be used to implement Green IT strategy for the benefit of organisations and society at large.

The author takes into consideration that Green IT implementation has the potential to preserve the environment through the optimisation of technology that seeks to adress ecological issues, reducing energy consumption and improving the management of e-Waste, ensuring compliance with environmental legislations by organisations and encouraging green culture. However, this can be realised through effective management of IT operations. As such, through Green IT implementation the energy cost will be reduced, natural resources will be preseved and the future of the present and future generation will be protected.

1.7 RESEARCH DESIGN AND METHODOLGY

The function of a research design is to ensure that the evidence obtained enables the researcher to answer the research question as unambiguously as possible. Obtaining relevant evidence entails specifying the type of evidence needed to answer the research question, to test theory, to evaluate the programme or to accurately describe some phenomenon. In other words, when designing research questions there is the need to ask, given the research question, what type of evidence is needed to answer the question in a considerable way (Bless, Smith and Kagee, 2006).

Essentially, methodologies are a precise philosophical and ethical approach to developing knowledge, a theory of how research should, or ought , to proceed given the nature of the issue it seeks to address (Nicholls, 2009:587). Therefore, a correct understanding and suitability of research techniques helps in making the best use of research resources and research methodology. The crux of this matter is that some disciplines are placing greater emphasis on quantitative research and some on qualitative research (Kothari, 2008).

The research conducted by Brynard and Hanekom (1997:27) defines secondary sources as data that are already in existence, for example, data recovered from sources such as databases or libraries. In this study, the secondary data collected are the result of other researchers' primary data collection. Some of the data that were collected for the study consist of a study of relevant published and unpublished materials, Green IT articles/journals, and academic books dealing with this subject matter, periodicals, and departmental reports.

In qualitative research, personal bias is recognised as an unavoidable feature of humanity, and one that is vital if there is exploration of the feelings, meanings and personal context of the participants' lived experiences and they reflect meaning. So, while qualitative researchers are equally as scrupulous in showing that their findings are trustworthy, they approach the question of bias differently. Underpinning this approach to the question of bias lies a fundamental difference in the way qualitative researchers view their participants (Nicholls, 2009). A qualitative approach of data gathering and analysis was used, including an analysis of official documents that discuss and the perspectives of the Green IT implementation. Semi-structured interviews were conducted. Qualitaitve interviews were conducted with eight South African companies.

The study followed an interpretive positivist paradigm with a qualitative approach. Positivist components were present due to the use of interview and the main approach was interpretivism. The researcher utilised a qualitative paradigm based on interpretivism to strive to comprehend how individuals in everyday setting construct meaning and explain events using their words (Fouche and Delport, 2002). The researcher believed that the qualitative approach was the sensible way to undertake this research because it is concerned more with meaning than measurement. Hence to achieve the objectives of this research the researcher adopts a qualitative approach. The research strategy of this study is the case study method.

1.7.1 Ethical Requirements

The conducting of research requires not only expertise and diligence, but also honesty and intergity. To render the study ethical and ensure anonymity, confidentiality and informed consent, written permission was obtained from the North West University and organisations participating in the study to conduct the research.

Ethical dilemmas raised during this research were taken into consideration throughout this research to develop and defines research problem, purpose(s), questions, data collection, data analysis and interpretation (Hollway and Jefferson, 2000:83). Bailey (1987:406) states that, research ethics are defined as the ability to conform to an accepted professional practice that already exists. The researcher followed the existing ethical practices with regard to data collection and the respondents involved throughout this research. One of the most important ethical responsibilities towards the people who are questioned or interviewed is that they should be protected from any form of harm when obtaining data (Du Plooy, 2001:348).

It was important that ethical issues be placed high on the research design agenda for any research endeavour. In exploring the effectiveness of statement analysis, the data collection and its interpretation were conducted and applied in the same ethical manner as cited in Creswell (2009:81).

For this research, ethical practices were considered in order to avoid their harmful effects on the subjects and data sourced from them and other materials (Mason, 1996:29). The research followed the guidelines of ethical principles to ensure the value of data integrity, impartiality and respect for participants and research communities (Creswell, 2009:87). The following guidelines were taken into cognisance during the research as detailed by authors such as Trochim (2006) and Denscombe (2003:134)

- Confidentiality of identities of interviewees and any information about identities (anonymity of subjects)
- Informed consent was addressed and an offer for free will to withdraw the consent and discontinue participation in the research interview at any time without prejudice.
- Avoidance of harm such as discomfort, anxiety, harassment, invasion of privacy or dehumanizing procedures during interviews.
- Honesty about information from participants was treated and used in such a way as to be secure and to ensure the anonymity and ethical responsibility.
- Respect for persons involved and a fair explanation of the purpose of the research, its possible dangers and the credentials of the researcher. The interests of participants were safeguarded.
- Sympathy was provided where necessary to participants.
- Voluntary participation was encouraged and participants were not coerced in any way to take part in this research
- Sharing of benefits (description of potential benefits to the subjects).
- A clear idea of precisely where and when the interview will take place
- The idea of length of the interview and that the researcher will take notes
- Full information about the purpose of the interview and research study and part thereof
- Clear idea of why they were interviewed (Westmarland, 2011:142).
- For the purpose of this study, the ethical Code of Conduct of the University was adhered to and research ethics code complied with in this research.

1.7.2 Representative Sampling

The researcher followed a case study method in order to obtain in depth analysis to develop a framework for Green IT implementation. Therefore, purposive sampling was chosen in relation to the research design and methodology because the researcher believed that this technique would yield a representative sample. Qualitative research usually deals with small samples and such samples can often have rich information and provide a good basis for indepth interpretation and analysis (Coyne, 1997). The universe of this study was eight South African companies in North West, Gauteng and Free State provinces. The study aimed at coming to conclusions on guidelines for the implementation of an effective Green IT framework for South African organisations.

1.7.3 Data Analysis

The data were collected and analysed using Soft packages such as Statistical Package for the Social Sciences (SPSS) statistics software package and Correspondence analysis. After collecting data, the researcher compared and contrasted the information given and then interpreted the data (Fink, 1995:43). The data of this study were collected through semi structured interviews. The data analysis of this study involved univariate, bivariate and multivariate analysis, since the research has inculcated qualitative approach. Furthermore, Correspondence Analysis was used to allow the researchers to understand the connection between the levels of variables. It was conducted by constructing cross tabulations between variables and plotting correspondence plots, relationships between levels of variables or lack of relationship that could be easily noticed. Accordingly, CA can disclose relationships that would not be identified using other non-multivariate statistical technique such as performing pairwise contrast. According to Healy and Perry (2000:118-126), realism has elements of both positivism and constructivism. The researcher of this study belongs to realism paradigm.

1.8 LIMITATIONS OF THE STUDY

The concern of the approach of this research relied heavily on the knowledge of respondents to IT. This study primarily emphasised the business aspects, rather than the technical aspects of Green IT.

1.9 EXPECTED RESULTS

The importance of Green IT is now at the forefront of technological civilisation, therefore business and society do not have to become victims of their own opulence (Albertson, 2008). IT is part of the environmental problem, and it can be part of the solution. Green IT is an economic, as well as an environmental imperative. It is and will continue to be a necessity, not an option. Therefore, adopting Green IT practices offers businesses and individuals financial and other benefits. Furthermore, IT operations achieve better energy efficiency through green initiatives (Murugesan, 2008:26-33).

The expected result of the study is to reduce GHG emissions resulting from the use of computing systems and IT related activities and encourage technology optimisation, improving energy effeciency of IT technologies, reducing e-Waste through effective management systems, reducing environmental impact by conforming to applicable legislations and regulations, and developing a framework for succesful Green IT implementation in South African organisations, with the purpose of dealing with environmental problems and contributing to economic growth.

1.10 CHAPTER SUMMARY AND CONCLUSION

This study has the possible influence of making a valuable contribution to South African organisations because it relates to cost reduction and environmental sustainability to ensure survival of the present and future generations. In this regard, Green IT is seen as an enabler for environmental sustainability. It is evident from studies that IT operations inherently have negative effect on the environment in the sense that they consume large amounts of electricity and the disposal of IT equipment (e-Waste) causes the release of GHG emissions and contributes to climate change. Nevertheless, little research has been done to examine the potential of Green IT. Moreover, the resistance to change, apathy and competing priorities have become universal problems for Green IT adoption **(**Hilty and Lohnmann, 2011:12).

The role of IT in resolving eco-sustainability issues (usually referred to as Green IT) is an under researched area. Therefore, the long term effects of pollution over the past decade have seen many businesses realising ways to improve their environmental footprint and taking responsibility for their actions. In context, Green IT holds promise for addressing the broader environmental and health issues in organisations. However, the impact of Green IT implementation in creating a sustainable environment is presently unknown. The study focused on the demonstration that the results of Green IT, if not adopted will lead to the escalating cost of energy, lessening of natural resources and rise in concern for the environment by the general population. It is important to note that Green IT holds promise for addressing the broader environmental and health issues in organisations.

1.11 THESIS LAYOUT

The study is divided into 7 chapters that include, Chapter 1, which is the introduction of the thesis to provide a usable synopsis of what the study intends to achieve, glossary of terms, background and context which discuss the importance of Green IT implementation and the benefit that will be derived by organisations and the environment, then after that the research discusses the problems and issues of the research topic in detail, then proceeds to the next part which is the research objectives, importance and significance of the study, research design and methodology, limitations of the study and the results that can be expected of the research are discussed.

Chapter 2, is a review of literature relating Green IT implementation in South African organisations. This chapter provides an outline in terms of Green IT adoption in terms of definitions, carbon and GHG emission, environmental impact, electronic waste, power and energy consumption, corporate governance and social responsibility, Green IT strategies and the rationale for developing a framework for Green IT implementation among South African organisations.

Chapter 3, describes the research methodology used in this study, data collection method that was chosen, types of questions that were asked and development of interview questions, the population and sample size determination, data handling, validity and reliability, elimination of bias and concludes with the discussion of the researcher's compliance with research ethics.

Chapter 4, provides a detailed chronology of results obtained from Green IT implementation, a presentation of findings of research derived from the analysis and interpretation of statistical data.

Chapter 5, which consolidates the findings of the research derived from analysis and interpretation of statistical data, comprises the summary of the study and the findings per research questions and establishes a link between literature.

Chapter 6, discusses the findings from the study, addresses the research questions and develops a frame work and Process flow for Green IT implementation for Green IT implementation in South African organisations.

Chapter 7, discusses the summary of findings, provides limitations of the study, recommendations, highlights areas of future study, and addresses contribution to the body of knowledge and conclusion.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

In this chapter, the literature defines the different themes, theoretical foundations and methodological approaches that can be taken to ensure successful Green IT implementation in South African organisations. The literature deliberates about the factors that necessitate Green IT practices in relation to technology optimization to address ecological issues, conserving energy by using alternative technologies, disposing of computers and managing e-Waste, legislation and regulations that can help to address environmental issues.

The main objective of the literature is to develop a theoretical framework for Green IT implementation in South African organisations with the intent of responding to the research questions and identifying flaws or gaps in the study (Webster and Watson, 2002). The literature review ensures that this study supports the claim of a rigorous review and highlights the problems of the research by contributing an original and significant influence to the body of knowledge. It addresses subjects in relation to the issue of GHG effects, impact of IT equipment on the environment, challenges of electronic waste, effects of power and energy consumption on business and environment, effects of corporate governance and Green IT strategies on the business.

Despite the widespread use of IT across the world, underneath lies the belief that it is contributing to environmental problems. The phenomenon of IT has been thoroughly explored and is defendable by evidence that IT consumes large amounts of electricity, and consequently places a load on electric grids (Murugesan, 2008:24). The truth is that environmental degradation and climate change have become a challenge for society. Therefore, action is required to stop the loss of biodiversity in order to tackle climate change for sustainability of the planet ecosystems and survivability of mankind (The Editors, 2009:7; Tomlinson, 2010:4).

In today’s dynamic and turbulent business environment, it is important for organisations to make their business cost effective and sustainable through the adoption of Green IT (Uddin and Rahman, 2012:4078). The rationale for this decision is that, Green IT application can be seen as a facilitator for the creation of green jobs, and an effective tool for reduced carbon and sustainable development (Semine, 2009). Green is connected with the sense of environmental awareness which is a concern for the ecosystem in which humans exist (Tomlinson, 2012:2).

This review of literature has been done through the following search engines: Nexus, Elsevier, SA Publications, Emerald, EBSCO, Sabinet, Science Direct and Google Scholar. The keywords applied were that of Green ICT, Green IT, Green Computing, Environmental sustainability, E-Waste, Green technologies in terms of definitions and theories from reputable articles and journals.

This chapter provides an outline of Green IT adoption in terms of definitions, carbon and GHG emission, environmental impact, electronic waste, power and energy consumption, corporate governance and social responsibility and Green IT strategies.

2.2 THE EFFECTS OF CARBON AND GREEN HOUSE GAS EMISSIONS

2.2.1 The effect of Greenhouse gas emission

In this section, carbon and GHG emissions are reviewed. It is acknowledged that GHG is caused by energy consumption through the use of IT and it is growing at an incredible pace (Bate, 2005; Borggren et al., 2013:126; Uddin and Rahman, 2012:4079-4080). According to the EPA Report (2009), the current energy consumption in data centres contributes to annual increase of the GHG and exacerbates environmental changes. The argument is that, this high level of electricity usage is a significant source of GHG because the data centres account for 50% of the total corporate carbon foot print which is substantially high. The consequence of this situation is the contribution to climate change (Hanne, 2011:425). The literature suggests that energy consumption is connected to GHG emission and is directly linked to climate change (Huang, 2009:115; Khan et al., 2014:343). In view of these concerns, Murugesan (2008:24) warns that IT is placing a load on electric networks and eventually contributing to GHG that result in the future becoming grim.

South Africa has high levels of emission which continue to increase despite the Kyoto Treaty. These GHG emissions continue to spiral at high levels, despite the country’s ability to tackle these GHG because South Africa is an active member in the Kyoto processes that are committed to mitigating climate change (Devarajan et al., 2009:2). In today’s competitive business environment, a programme in support of energy efficiency should be launched to enhance economic growth and abate these GHG (Vine and Hamrin, 2008:467). Unless, of course, there is deployment of existing technologies to produce renewal energy and bring greenhouse gas emission under control, these GHG will continue to grow (Easterbrook, 2010:99; Tomlinson, 2010:5).

2.2.2 The effect of Carbon emission

A computer produces an estimate of 10% carbon emission through energy consumption which has drastic environmental impact (Huang, 2009:115). Unfortunately, these increased carbon levels continue to plague the earth for future generations (Harmon and Auseklis, 2009:1709). This can be generally explained that the high level of energy consumption implies greater magnitude of carbon emissions, which are less favouring green concept and economic prosperity (Mattern, Staake and Weiss, 2010). To be more explicit, GHG blanket the earth naturally and are responsible for climate change (Lakshmi, Sarwani and Tuveera, 2012:1283).

Previous studies highlight that IT industry is accountable for 3% of global emissions which is approximately equivalent to the aviation industry, and projected to increase by 6% during 2020. Should the existing trend continue consistently it will grow more than predicted by 2020, thus posing unmanageable worries and creating a new climate of uncertainity (Campbell, Ratcliffe and Moore, 2013:126; Cater-Steel and Tan, 2010:107; Gartner, 2008; Petzer, McGibbon and Brown, 2011:330). According to Kavuri (2013), GHG have increased by 25%, and are caused by gases such as carbon dioxide, methane, nitrous oxide and fluorinated gases that are being released into the atmosphere because of industrialization. This unpleasant scenario is continually increasing in many regions and biodiversity continues to decline, because human activities are ecologically disruptive and threaten environmental sustainability (Leemans and Solecki, 2013:272). In order to avert this challenge, waste and emissions should be prevented to protect the environment and address important sustainability issues (Rahim and Rahman, 2013:82).

A flexible, dynamic and secure Green IT framework is required to deal with unprecedented increases of energy and reduce carbon footprint which is likely to impact economies, health and resources (Uddin and Rahman, 2012:4079-4080). Research shows that the most common reason for organisations in Green IT is the benefits it provides including the reduction of power consumption cost, low carbon emissions and reduced environmental impact. Ultimately, it helps with designing greener products (Bose and Luo, 2011:39; Butler, 2010:2; Mattern, Staake and Weiss, 2010; Siddiqui, 2013:410; Vykoukal, Wolf and Beck, 2009; Yunus et al., 2013:241-242).

2.2.4 The effects of Carbon footprint

A review of the literature reveals that the relation between carbon footprint and IT equipment is increasing at an unprecedented rate, and should this trend remain constant IT will be classified among the highest greenhouse gas emitters by 2020 (Boccaletti, Loffler and Oppenheim, 2008:1-2). Moreover, a number of studies indicate that IT industry carbon footprint is on the verge of exceeding the aviation industry because its rate of energy consumption and carbon emission is doubling every 5 years. It is thus extremely important to intervene in this regular increase demands (Gartner, 2008; Cater-Steel and Tan, 2010:107; Siddiqui, 2013:411; Riaz, Gutierrez and Pedersen, 2009). The increasing use of IT devices is making a substantial contribution to the carbon footprints of organisations through its use, construction and disposal. In turn, this has detrimental and irreversible impact on the environment (Campbell, Ratcliffe and Moore, 2013:127).

Inefficient environmental administration and human activities disturb the carbon cycle in a manner that is ecologically disruptive to cause climate change. GHG emissions in the atmosphere absorb and re-emit some of the outgoing energy radiated from the earth's surface causing heat to be retained in the lower atmosphere. Notably, some GHG emissions remain in the atmosphere for decades (50 to 200 years), and therefore can affect the earth's energy balance. It is predicted that this carbon dioxide will increase significantly by 2020, exacerbating environmental changes on a global scale which requires immediate attention to prevent its adverse environmental impact (Kavuri, 2013). Several studies suggest that IT significantly increases carbon footprint for organisations because its equipment and network have shorter product life spans. In contrast, IT plays a prominent role in the battle against climate change, which has the potential to reduce annual global emission by 15% during 2020, which is the threat of climate crisis that is real, imminent and universal (Chowdhury, 2012:639; Molla et al., 2008:671).

The reasons for organisations developing interest in carbon foot print reduction can be found in green regulations formulated by environmental agencies. These green regulations were formulated by the European Union in an effort to ensure that organisations become environmentally friendly and restrict the use of toxic and flame-retardants by the manufacturer of electrical and electronic equipment (Sinha, 2011). The truth is that organisations are adopting Green IT in order to decrease carbon footprint which is posing negative impact to the environment, distorting seasons, altering rainfall patterns and causing sea level to rise (Rogers et al., 2013:974). Green IT implementation has the potential of creating a fertile ground for economic opportunity for organisations by limiting and reducing the organisation's overall footprint (Molla et al., 2008:671; Rahim and Rahman, 2013:242; Rogers et al., 2013:974; Semine, 2009; Siddiqui, 2013:410; Talebi and Way, 2009).

2.2.5 The importance of Carbon reduction

Previous studies reveal that carbon footprint is driving climate change and should be reduced in order to advance computer systems, because if it is not addressed, it will result in negative outcomes that include severe, long-term, destructive economic impacts (Uddin and Rahman, 2012:4079). The growing accumulation of GHG emissions released into the atmosphere contributes to climate change, which is daunting and merits urgent attention (Murugesan, 2008:25). However, IT has the potential to prevent pollution of GHG which pose a threat to society, despite its negative concerns (Molla and Abareshi, 2012:93). In a broader sense, this GHG emission reduction is intended to enhance the image of organisations (Boiral, 2006:326). As a result, organisations are advised to consider their carbon footprint and redesign their business process, in order to decrease carbon emissions (Cater-Steel and Tan, 2010:107). It is for this reason that the European Commission has provided a mandate for the IT industry to develop strategies and cut emissions by 15% by 2020. Furthermore, it is important for organisations to reduce carbon and move towards energy systems that incorporate greater use of renewal energy technologies to mitigate climate change (Walker and Cass, 2007:458-467).

The South African population is becoming more urbanized and has comparatively high level of e-Waste and pollution impacting on air, land and water. Moreover, e-Waste disposal practices are unacceptable due to poor regulatory controls. This suggests that the country faces enormous challenges in addressing IT related environmental concerns (Couth and Trois, 2010:16). It is thus important for organisations to find ways to significantly slow the onslaught of climate change, which is a formidable task for decision makers globally (Devarajan et al., 2009:27).

The review of literature indicates that greenhouse gas reduction is required at an international level to stop the loss of biodiversity, and increase sensible use of natural resources (The Editors, 2009:7). Therefore, organisations need to adopt Green IT to achieve this mandate (Bose and Luo, 2011:39; Couth and Trois, 2010:16; Welfens and Lutz, 2012:159). Green IT has the potential of addressing a wide range of environmental challenges that affect the health and wellbeing of humans and organisations in an adverse manner (Berthon et al., 2010:16; Boiral, 2006:318; Chow and Chen, 2009:136; Molla and Abareshi, 2012:93; Siddiqui, 2013:410;

Robin, 2010:1). In contrast, Green IT implementation should provide value for the business by allowing carbon efficiency, processes, systems, technologies and work practices to encompass a holistic business strategy (Unhelkar, 2011:59).

2.3 THE IMPACT OF IT EQUIPMENT ON THE ENVIRONMENT

Environmental impact refers to the degree to which an organisation's business processes, activities and operations positively or adversely affect the natural environment (Jenkin, Webster and McShane, 2011:17-18). In context, it is important to comprehend that IT has the potential of causing environmental problems (Childs, 2008; Korte, Lee and Fung, 2012:2). Previous studies reveal that a large number of IT pieces of equipment have been manufactured, used and disposed of thereby causing alterations in the earth-atmosphere (Fairweather, 2011:68). A further challenge is that, IT is spreading globally and its negative environmental impact, such as energy consumption and waste production, is significantly growing, causing environmentally damaging patterns of resource. However, in spite of these growing challenges, IT can play a role in the global effort to reduce the impact of human activities on the environment (Huang, 2009:114-115; Jorgensen and Jorgensen, 2009).

An important factor in the rise in Green IT adoption by organisations is the environmental impact caused by IT products (Zhang and Liang, 2012:1000). The intent of implementing Green IT initiatives is to tackle environmental issues from the threat of catastrophic climate change as a result of IT use (Campbell, Ratcliffe and Moore, 2013:127; Chowdhury, 2012:639; Hanne, 2011:424; Lakshmi, Sarwani and Tuveera, 2012:1282; Mingay, 2007; Zhang and Liang, 2012:1000). In particular, green technologies should help organisations to conserve the natural environment resources to achieve environmental sustainability (Sinha, 2011). It is important for organisations to minimise environmental impact and maximize energy efficiency through efficient use of IT resources to correct this accelerating rise of carbon emission (Chong et al., 2010:84).

2.3.1 Ecological issues relating to IT

It is acknowledged that people have reasons to desire environmental protection. The growing ecological crisis and social risk brought by industrialization contribute to irreversible changes of climate because of IT use (Shuanggui, Jing and Shiyuan, 2011:253). The ecological issues of IT products and service design need to be addressed in order to deal with e-waste and pollution that is responsible for increases in atmospheric carbon concentrations and environmental degradation (Hanne, 2011:424; Harmon and Auseklis, 2009:1707). To be clear and specific, ecological issues provide an alert on the use of technology resulting in organisations reacting in a sustainable way to protect the environment from the deleterious consequences of carbon-induced climate (Berthon et al., 2010:16; Tomlinson, 2010:2).

Eco-sustainability has become an agenda item for Green IT adoption to make peace with the planet (Molla and Abareshi, 2012:93; Petzer, McGibbon and Brown, 2011:330). Despite many environmental challenges, organisations are adopting eco-sustainable approaches in order to abate pollution and protect the environment from the brittleness of the earth's ecosystem and the potential of irreversibility of climate change (Ramayah et al., 2013:247). Accordingly, Smith and Perks (2010:3), Trimi and Park (2013:363) believe that environmental issues are the centre of focus for business globally to avert global catastrophe caused by IT usage. At large, ecological sustainability connects the human needs without compromising the health of the ecosystem because the effects of climate change are far-reaching and carbon is the culprit (Morelli, 2013:2).

The ecological forces symbolise the degree of reduction of natural resources and technical forces provide a description of the external resources, natural and artificial, that are available to the organisation to act in an environmentally sustainable way and avert disastrous climate change (Jenkin, Webster and McShane, 2011:19-31). In the greater scheme of things, within organisations, ecological sustainability warrants higher level of priority than sustainable economic development because the warming of the atmosphere has become an environmental concern (Chen, Boudreau and Watson, 2008).

In general, organisations should be encouraged to reuse, remanufacture and recycle IT used products in order to reduce the harmful effects to the environment and become ecologically responsible (Chung and Wee, 2010:466; Harmon and Auseklis, 2009:1707; Petzer, McGibbon and Brown, 2011:330; Ramayah et al., 2013:247; Shah, 2012:5). It is extremely important to understand that the adoption of Green IT is perceived to be an enabler for environmental sustainability (Chen, Boudreau and Watson, 2008; Petzer, McGibbon and Brown, 2011:330). The locus of motivation for organisations to adopt Green IT is because of the ecological sustainability context and preventative measures of ecological change that are desperately needed (Viaro and Vaccaro, 2010:2). Green IT explores the ways in which environmental issues and IT are connected to each other regarding the nature and degree of climate change in order to prevent future peril (Tomlinson, 2010:2-3).

2.3.2 The impact of climate change

Climate change and environmental degradation are challenges facing society currently because of the GHG that are released into the atmosphere, causing disruption to the natural ecosystems. As a result, action is needed to halt biodiversity, reduce GHG and tackle climate change because failure to take action will exacerbate environmental damage caused by IT (Charnoviz, 2012:45; The Editors, 2009). The essence of this climate change phenomenon is carbon dioxide that is emited through fossil burning from industrial revolution and transferred into the atmosphere causing environmental degradation, loss of biodiversity and economic uncertaintity. It is essential to note that climate change is a complex phenomenon for multiple generations because the climate models currently used will be of less interest in the next 100 years. As a result, the annual flow of emissions exacerbated the associated environmental problems (Wunsch, Schmitt and Baker, 2013).

Climate change is the consequence of human activity because of the human apetite for energy that appears to be insatiable (Jugovic et al., 2013:261). The effects of climate change give rise to environmental awareness because of the negative impact to the environment that is rising at an unprecedent rate (Smith and Perks, 2010:2). It is evident that climate change is the most significant environmental subject confronting the world today, because it poses a threat to human wellbeing and environmental intregrity (Chowdhury, 2012:634; Whitmarsh, 2009:401-403). In context, this climate change arises from GHG emissions and energy use which is a critical issue that poses a threat to the global economy faced currently. Failure to bring these emissions to a halt will eventually impede economic prosperity and lead to catastrophic results (Easterbrook, 2010:101; Lee, Park and Trimi, 2013:629; Starkey and Anderson ,2005:2). The theory of GHG emissions is that they trap heat in the atmosphere and ultimately contribute to climate change, a complex problem that the world has faced for decades, and requires uprecedented and urgent leadership, innovation and commitment (Nishant, Teo and Goh, 2012).

The report of the Worldwatch institute shows that the main greenhouses that trap infrared radiation contributing to climate change are carbondioxide (77%), nitrous oxide (8%) and methane (14%). It is acknowledged that these greenhouses are causing further damage to the world ecosystems (Khan et al., 2014:337). Studies highlight that climate change makes it increasingly urgent for organisations to pursue Green IT to tackle economic and environmental problems through wide array of intervention methodologies and technologies (Zhang and Liang, 2012:997). According to Berthon et al. (2010:14), companies should be held accountable for issues of climate change. As a result, it is imperative that organisations should adopt Green IT (Vykoukal, Wolf and Beck, 2009).

In principle, the activities for carbon footprint reduction imply going "Green", which leads to environmental sustainability preventing further damage to the ecosystem (Talebi and Way, 2009). The United Kingdom's Department of Energy and Climate Change guideliness show that carbon impartiality can be achieved by altering the processes of production, distribution, storage, processing, use and disposal, embracing green user behaviour, using alternative energy sources and carbon sequestration (Chowdhury, 2012:636-639). The Kyoto and Copenhagen Regional and International Environmental Conferences Report (2009), also displayed a growing interest in conserving the environment and addressing ecological issues involving climate change and biodiversity. In contrast, the United Nations Framework Convention on Climate Change (2009), indicates that the current estimate of GHG emissions should be reduced by 80% by 2050 if catastrophic climate change is to be avoided.

2.4. THE CHALLENGE OF ELECTRONIC WASTE

The term e-Waste is regarded as anything that runs on electricity/battery or has wire and has completed its life cycle (Shagun, Kush and Arora, 2013:490). In contrast, Wath, Dutt and Chakrabarti (2011:249), Tocho and Waema (2013:99), explain electronic waste (e-Waste) as the term that describes old, end of life electronic appliances which have outlived their shelf life and are disposed by organisations in growing quantities and reaching disatrous proportions. Research studies reveal that e-Waste is the fastest growing problem globally and has become a topic of concern for electronic industries because of the rapid accumulation of unused (obsolete) computers which have become part of the growing stream in landfills (Advanced Tropical Environment, 2012:11; Billinghurst, 2005:400-4004; Hodges and White, ND; Kiddee, Naidu and Wong, 2013:1237; Mingay, 2010; Nnorom and Osibanjo, 2008:844; Salmani and Sharifian, ND; Tocho and Waema, 2013:99).

There is a strong evidence that suggests that IT equipment creates a significant amount of e-waste which is constantly growing at a rapid pace and accounts for about 2 % of municipal solid waste. The true percentage is undoubtedly much higher than estimated (Huang, 2009:115). This means that e-Waste is an increasing global problem due to the quick obsolence of electronics which make up to 70% of hazardous waste resulting in crisis and generating frustrations (Bose and Luo, 2011:42; Chakravarthy, Kumar and Ragav, 2013:1; Whitley, 2001:1). The replacement of older pieces of IT equipment with new ones is a common practice by organisations that wish to promote economic activity. However, computer production accounts for subtantial environmental impact because of its frequent replacements which are the drivers of e-Waste production (Fairweather, 2011:71; Robinson, 2009:184). In the end, e-Waste is rising at a frightening speed and is a concern on local and global scales because of its economic and social impact (Gupta et al., 2013:11; Salmani and Sharifian, ND; Tanskanen, 2013:1001; Tomlinson, 2010:3).

An estimate of about 200 million computers became obsolete in one year, and the number has significantly increased since 2005 when an estimate of 130,000 computers were discarded every day. Consequently, these discarded electronic gadgets contain a multitude of toxic metals and chemicals contributing to environmental problems because they are illegally dumped and there is little control of e-Waste (Uddin and Rahman, 2012:4081). In other words, great volumes of e-Waste are being produced because of change in the consumption and rapid advancement of technology that have become a challenge for organisations (Chibunna et al., 2009:549).

In accordance with the European Union waste electrical and electronics equipment directive, the terms waste electrical and electronics equipment and “e-Waste“ are used synonymously, meaning, any electrically powered appliance that fails to please the owner for its initially anticipated purpose (Bandyopadhyay, 2008:1507; Campbell, Ratcliffe and Moore, 2013:127). According to Begum (2013:46), it is estimated that about 50 million tons of e-waste is being produced in the world annually. Understanding its implication, this e-Waste has become a primary concern that requires action from developing countries such as South Africa, because they are inadvertently becoming the dumping ground for developed countries (Holmner and Marais, 2013:136; Onwughara et al., 2010:290; Sthiannopkao and Wong, 2013:1153). A good argument edge is that e-Waste is omnipresent and is causing substantial environmental dreadful conditions in poor countries thereby adversely affecting the health of the people (Robinson, 2009:189).

Technology advancement will increase e-Waste generation in South Africa and the greatest concern is how it will affect the community (Holmner and Marais, 2013:136). The relative consumption and technology advancement increase the diversity and complication of electrical and electronic waste and create high volumes of e-Waste (Chibunna et al., 2009:549). In contrast, environmental footprint and the reduction of e-Waste can create positive outcomes through utilising scarce resources proficiently and effectively, thererby keeping the environment free from harmful IT products (Jenkin, Webster and McShane, 2011:18; Smith and Perks, 2010:3).

The Basel Convention International Regulations experienced difficulties for e-Waste management to be implemented effectively (Widmer et al., 2005:436-454). In general, e-Waste is generated by small and large businesses, institutions and governments and equipment manufactures, causing its disposal to be conducted in an unenvironmentally friendly manner (Avvannavar and Shrihari, 2007:309-310). It is predicted that 80% of e-waste is generated by government and businesses resulting in high levels of waste in the dumping sites. This situation perpertuates the need for organisations to respond to this inevitable growing challenge (Lawhon, 2012:70). It is belived that the development of new technologies will change the production of e-Waste and enourage economic growth (Robinson, 2009:185).

The literature review reveals that there is no legislation in South Africa dealing with e-Waste to protect the public and the environment in order to maintain and improve the quality of life (Advanced Tropical Environment, 2012:26; Khurrum et al., 2011:3). Moreover, waste management in South Africa receives poor funding and is not properly coordinated. This indicates that the key challenges of e-Waste in South Africa include illegal dumping, unlicenced waste management, overuse of landfills, insufficient waste minimisation, lack of waste information and legislation enforcement (Muzenda, 2013:79). However, International Organisation for Standardisation (ISO) 14001 standard can help the organisations to improve their environmental performance (Cater-Steel and Tan, 2010:110).

There is strong evidence that suggests that ISO14001 provides a framework to forster the implementation of an enviromnental policy through classic management principles (Boiral, 2006:326). The primary motivation that organisations are moving towards Green IT is to save money and reduce waste (Clarke, 2009:19). Green IT implementation ensures that the use of new hardwares consumes less energy, easy to dispose of and environmentally friendly. In turn, they provide environmental stewardship through proper disposal of waste and toxic hardware (Uddin and Rahman, 2012:4082; Gavrilovska, Zdraveski and Trajanov, ND).

2.4.1 The effect of hazardous raw material on the environment and health

The quantities of electrical and electronic equipment put on the market show an increasing trend for the industrialised and developing countries. South Africa generates an estimated 2, 000, 000 tons of e-waste annually which are sent to landfills and contain poisonous substances that can leach from decomposing waste into the environment (Advanced Tropical Environment, 2012:17-20). The problem that arises now is that these toxic and hazardous materials contained in e-Waste are contributing to environmental pollution and have the potential to cause brain damage, allergic reactions and cancer if they are inadequately treated and disposed of. A further challenge is that e-Waste results from inappropriate processing rather than inherent toxic contents (Bates, Mbeng and Phillips, 2008:210; Osibanjo and Nnorom, 2007:494-500; Petzer, McGibbon and Brown, 2011:331; Tanskanen, 2013:1002).

It is predicted that e-Waste is increasing at a level of 3 to 5% per annum more than individual waste streams, and it contains complicated assembly of 1,000 different substances which are highly toxic and potentially harmful to the environment and human health (Gupta et al., 2013:11; Herat, 2007:305; Kiddee, Naidu and Wong, 2013:1238). In this regard, several studies indicate that e-Waste disposal is a problem because it is responsible for 70% of the toxic chemicals such as brominated flame retardants, beryllium, antimony, phthalates, mercury, arsenic, selenium, hexavalent chromium, lead, cadmium and polychlorinated biphenyls, polybrominated diphenyl ether and polybrominated biphenyls which require special end of life handling and are a threat to human health and the environment if they are improperly discarded (Bandyopadhyay, 2008:1507; Begum, 2013:47; Chen, Boudreau and Watson, 2008; Chibunna et al., 2009:549; Fuchs, 2008:300; Gavrilovska, Zdraveski and Trajanov, ND; Herat, 2007:305; Hilty et al., 2006:30; Kiddee, Naidu and Wong, 2013:1238; Jenkin, Webster and McShane, 2011:18; Murugesan, 2008:25; Onwughara et al., 2010:291; Osibanjo and Nnorom, 2007:490; Parthasarathy, Bulbule and Murthy, 2008:93; Ruth, 2009:74; Saphores et al., 2009:1-2; Shagun, Kush and Arora, 2013:490; Talebi and Way, 2009; Terazono et al., 2006:2; Williams et al., 2008). The consequence of this situation is that should there be no reduction in this toxic waste, the earth will not be a sustainable living environment for any creature (Chow and Chen, 2009:136). It is evident that this hazardous waste is a threat to the environment, global justice, physical and ethical wellbeing (Bates, Mbeng and Phillips, 2008:210). It is for this reason that restrictions on hazardous substance (RoHS) objectives were developed to ensure that the product designs limit the use of these toxic substances (Sthiannopkao and Wong, 2013:1148).

It estimated that about 80% of electronic equipment end up in the landfills and are highly toxic. Moreover, there is a little formal governance over e-Waste and its recycling (Hogan, 2011:9-10; Lawhon, 2012:76). The consequence of this situation is that improper recycling and e-Waste incineration is emitting toxic fumes and gases which pollute the atmosphere (Begum, 2013:47; Hanne, 2011:425; Holmner and Marais, 2013:137). In view of literature, the waste management activities in the landfills produce methane (Kavuri, 2013) and contribute approximately 3 to 4 % of the annual global anthropogenic GHG emissions at solid waste landfill sites. It has a molecule that has a relatively large climatic change impact. Therefore, it is essential to take action against this negative trend of improper e-Waste management (Couth and Trois, 2010:1).

The review of literature reveals that technological advances have not achieved any reduction in resource use or waste volume which is hazardous to human health and the environment (Fuchs, 2008:296). Advanced Tropical Environment (2012:14) points out that e-waste Association of South Africa is the only organisation in the country currently managing e-waste through activities of refurbishing, reusing and recycling in order to prolong the life cycle of electronic products and minimizing e-waste. Therefore, the obstacle of adressing e-Waste in South Africa is the lack of comprehensive data and systematic studies to determine the magnitute of the e-waste problem in the country.

The intention of the Basel Convention was to eliminate, mitigate and keep hazardous waste within the countries that have the capacity to handle them (Sthiannopkao and Wong, 2013:1148). Similarly, an intergrated waste management plan is required to adress e-waste volumes. Moreover, the case study of countries such as Switzerland are a good benchmark, because of their technological sophistication and effective and efficient procedures to manage e-Waste which has become a daunting task for organisations (Advanced Tropical Environment, 2012:14). However, organisations are responding to the rising volumes of e-Waste challenge through the development of waste management systems (Lawhon, 2012:70). In the same way, Tocho and Waema (2013:99) are also of the opinion that institutional infrastructure for e-waste collection, transportation, treatment, storage, recovery and disposal need to be established to achieve ecologically sound administration of e-waste. In order to reduce the use of hazardous materials and protect recycling or biodegradability of default product and factory waste, the organisations are required to take drastic measures (Siddiqui, 2013).

2.4.2 The challenge of Information and Technology waste disposal

Organisations are typically replacing their IT equipment every three years, and some of these pieces of IT equipment ultimately end up in overflowing landfill sites producing contaminated leaches which ultimately pollute ground water (Begum, 2013:47; Murugesan, 2010:4; Murugesan and Molla, 2011:40; Plambeck and Wang, 2009:346; Watson, 2009:7). The reason for the accumulation of e-Waste is because it is uncoordinated at the national and regional levels of government. As a result, it is simple to throw electronic waste away (Murugesan, 2013). According to Advanced Tropical Environment (2012:28), the life span of IT products is between 4 to 5 years, and most of them become obsolete before losing their capacity and are cannibalised for spare parts. Unless, of course, the discarded obsolete pieces of equipment that require replacement is addressed, they will continue to pose environmental threat because of their potential harmful effects (Cairns, 2005; Molla and Abareshi, 2012:93; Salmani and Sharifian, ND; Vykoukal, Wolf and Beck, 2009).

The increasing demand of IT products has inevitably resulted in an increased amount of obsolete, discarded, broken and abandoned products which require reduction and treatment, and has created a waste crisis that is out of control (Avvannavar and Shrihari, 2007:312; Berthon et al., 2010:17; Osibanjo and Nnorom, 2007:492). As a result, the obsolence of IT products presents a challenge for managing e-Waste and has the potential of causing organizational environmental degradation (Kuo and Dick, 2009:81-82). Chakravarthy, Kumar and Ragav (2013:5), Shah (2012:17), Murugesan and Molla (2011:40), write that outdated computers and other electronics are treasured sources of secondary raw materials when they are properly treated, if not, they become the source of toxins and carcinogens because they contain toxic substances. It is universally acknowledged that e-Waste is an emerging problem and business opportunity for organisations because of the volume of e-Waste being created and the contents of toxic and valuable materials contained in disposed IT products (Chakravarthy, Kumar and Ragav, 2013:5; Khurrum et al., 2011:1; Salmani and Sharifian, ND; Siddiqui, 2013:412; Smith, 2004:269; Vykoukal, Wolf and Beck, 2009; Widmer et al., 2005:436-437). In line with this concern, IT products such as computers, printers, scanners and compact discs are difficult to dispose of (Sinha, 2011).

It is estimated that disposed computers and their related electronic parts contribute 40% of lead, thus posing a threat to the environment and human health (Smith, 2004:266). Kahhat and Williams (2009:43) envisaged that landfilling of electronics should be banned because of their toxic materials causing environmental impact. Furthermore, electronic products have gained popularity and organisations have stockpiled e-Waste and don’t know how to dispose of it (Saphores et al., 2009:3). Watson (2009) indicates that IT equipment is unncessarily destroyed which is against the European Union Waste Electrical and Electronic Equipment Directive, which strive to decrease the environmental effect of waste that ends up overflowing on land sites. In addition, Gaidajis, Angelakoglou and Aktsoglou (2010:197) indicate that the Directive

2002/95/EC, and RoHS were intended to restrict the use of hazardous substances causing environmental problems during recycling of waste electrical and electronic equipment, and ensure substantial reduction of health and environmental hazard in the replacement of IT products with safer substances. According to Fairweather (2011:72-74), IT has the potential to reduce waste and reduce environmental pollution that is of constant concern globally.

South Africa is facing a challenge when it comes to e-Waste recycling because refurbishers and recyclers are not ISO compliant. In contrast, informal recycling of e-waste in developing countries is evolving as a new environmental challenge because of improper treatment methods (Bandyopadhyay, 2008:1507; Osibanjo and Nnorom, 2007:495). The major contributing factors to the e-waste problem are the manufacturers who design computers for disposal, and with materials in their products that are not easy to recycle or disassemble (Billinghurst, 2005:404). According to Onwughara et al. (2010:294), without a well-developed recycling and refurbishing programme in developed countries, health risks are expected because the products are shifted from one part of the world to another. In line with this view, there is a current debate over the best approach to handle the challenge of recycled and used e-waste. In addition, there are various recycling models which include setting take-back programmes, recycling based on products returned and based on the selling price (Linnell, 2009:78). Similarly, Mingay (2007) supports the notion from the "take it back pricinciple" that it is likely to address the issues relating to e-waste.

According to Shagun, Kush and Arora (2013:490), some exporters are being accused of intentionally making it challenging to recycle obsolete or non-repairable equipment mixed in loads of working equipment and sending them to developing countries. However, developing countries lack waste removal infrastructure and technical capacities necessary to ensure safe disposal of hazardous waste because illegal import of e-Waste has become a burning issue (Khurrum et al., 2011:2). The Environmental Protection Agency estimates that 15-20% of e-waste is recycled, and the rest of electronics destination is landfills and incinerators magnifying environmental problems (Begum ,2013:46; Shagun, Kush and Arora, 2013:490).

The literature review shows that e-Waste recycling can recover 95 % of useful materials from a computer through disassembly and destruction of the equipment. However, most of e-Waste is not recycled but exported to poor countries exacerbating the global challenge (Robinson, 2009:187). Studies reveal that e-Waste contains valuable hazardous material and requires exceptional control and recycling method to avoid environmental pollution and negative effects of human health (Robinson, 2009:184). According to Sthiannopkao and Wong (2013:1148), the "3Rs" Reduce (preventing waste creation), Reuse, and Recycle" initiative introduced by Japan at the 2004 G8 summit is highly recommended to address e-Waste which has become a complex phenomenon. In this regard, the unwanted IT equipment should not be discarded, but should be refurbished and upgraded by reconditioning and replacing some electronic parts to prolong their life span (Gupta et al., 2013:11; Molla and Abareshi, 2012:92; Murugesan, 2008:24; Murugesan and Molla, 2011:40; Waiti and Koo, ND). As a result, recycling of WEEE is considered lucrative when materials are recuperated in the recycling process (Tanskanen, 2013:1002).

E-Waste is a significant target to manage national and international material cycles for environmental preservation and resource utilisation (Terazono et al., 2006:1-2). On the contrary, Billinghurst (2005:409), Gaidajis, Angelakoglou and Aktsoglou (2010:197) indicate that the Directive of 2002/95/EC regarding waste electrical and electronic equipment has been established to help in the decline of waste electrical and electronic equipment to encourage more proficient use of resources through recycling and re-use, and provide restriction on the use of hazardous substances of new electronic equipment. In contrast, Advanced Tropical Environment (2012:96) points out that South Africa does not have the capacity to manage e-waste because e-Waste recyclers and refurbishers are not ISO compliant and Health Safety and Environment standard is not enforced resulting in potentially hazardous e-waste being disposed of in landfills. As a result, the management of e-waste suffers drawbacks because of the lack of appropriate e-waste recycling technology, illegal imports and unhealthy conditions of informal recycling (Tocho and Waema, 2013:100). However, e-Waste recycling has the potential, and it is both an opportunity and threat for the people in developing countries (Hilty et al., 2006:30).

Despite the Basel Convention being adopted to reduce transboundary movement of hazardous waste, some developing countries continue to face economic pressure to continue the hazardous waste trade (Billinghurst, 2005:407). According to Khurrum et al. (2011:2-3), there is slight or no actual enforcement of regulations relating to e-Waste management and disposal, especially in Africa where e-Waste is unregulated. Besides, several regulations simply fail to address the management of e-waste. The destruction of IT equipment results in unnecessary waste being accumulated which is against the EU Waste Electrical and Electronic Equipment (WEEE) Directive to minimise environmental impact. Accordingly, it is imperative for organisations to create an environmental management system that comprises organizational structure, planning undertakings, obligation, practice, procedure, processes and resources for developing, executing, accomplishing, reviewing and upholding environmental policy as indicated in the ISO 14001 standard to manage e-Waste (Chou and Chou, 2012:450).

There is lack of developed policies that regulate the handling, discarding and importation of hazardous waste in developing countries (Holmner and Marais, 2013:136). It is for this purpose that The Advanced Tropical Environment (2012:96), indicates that South Africa needs to promulgate regulations which will make it compulsory for commercial and domestic producers of e-waste not to mix them with general solid waste. Moreover, for effective e-Waste management one institution is required because several institutions managing one product pose a danger to the effeiciency and sustainability of the system. Consequently, Green IT implementation will enable the organisations to conserve energy, reduce GHG emissions and manage the disposal of IT gadgets and hazardous substances, thereby creating a sustainable environment (Butler, 2010:6; Chong et al., 2010:84).

2.5 THE EFFECT OF POWER AND ENERGY CONSUMPTION

It is evident that pieces of IT equipment consume more energy when they are not in use. This means that IT consumes global energy twenty four hours a day causing the release of carbon dioxide into the atmosphere resulting in harm to the environment and impacting business negatively (Campbell, Ratcliffe and Moore, 2013:127; Fuchs ,2008:299; Gabriel, 2008:231; Huang, 2009:115; Siddiqui, 2013:412; The Editors, 2009:8; Uddin and Rahman, 2012:4079-4083). In this regard, the consumption of IT use is continually increasing at a rapid pace causing indisputable rise in carbon levels and creating a challenge for businesses, thus requiring immediate attention (Lee, Park and Trimi, 2013:631; Vereecken et al., 2010). According to O' Keefe, O'Brien and Pearsall (2010), energy is a major component for economic growth in organisations. However, it is characterized by structural weakness and geopolitical, social and environmental short coming.

Carbon emission in South Africa depends primarily on energy use and the carbon intensity of each energy input (Devarajan et al., 2009:6). The driver behind green movement for IT is the increased demand on energy resulting in GHG emissions and induced climate change, because IT accounts for 2 to 3 % of GHG emissions. To be more explicit, a molecule of carbon dioxide can remain in the atmosphere for up to 200 years and is a primary contributor to climate change (Murugesan et al., 2013:16). It is estimated that about 70% of GHG emissions are energy related and instead of business decreasing carbon emissions they are substantially increasing it. Therefore, organisations should find alternative clean resources to improve energy efficiency through the design and use of advanced technologies for environmental sustainability (Andreopoulou, 2012:1; Chowdhury, 2012:639; Lee, Park and Trimi, 2013:630; Mattern, Staake and Weiss, 2010; Rahim and Rahman, 2013:241; Ramayah et al., 2013:246-247; Uddin and Rahman, 2012:4080). Sinha (2011) reports that Gartner predicted that organisation expenditure on IT budgets for energy will gradually increase two or three times within the next five years. The total global spending on IT is projected to rise by 6.2% to 3.7 million trillion US dollars, which indicate a new growth cycle by market research. Global spending on computers is forecasted to grow by 6.6% on yearly basis. In this regard, the spending on IT activities is constantly on the rise. Therefore, investment in renewal energy is essential because it will result in competitive returns in some of the business market conditions (Devarajan et al., 2009:107).

2.5.1 The challenges caused by data centres

The study conducted by Uddin and Rahman (2012:4083), reveal that almost 90% of the servers remain idle and consume energy, in consequence, generating carbon that is hazardous to the environment and contributing to climate change. Many data centres are more than ten years old and reaching the end of their useful life. Consequently, they become power starving and inefficient, using 2 to 3 times the energy overall for cooling. This cost of energy that is gradually increasing to run the IT infrastructure is caused by expansion of data centres resulting in carbon footprint and escalating the business cost. It is expected that this pattern will grow constantly if this situation is not addressed (Harmon and Auseklis, 2009:1707; Khan et al., 2014:337; Murugesan, 2008:24; 2010; Nishant, Teo and Goh, 2012; Uddin and Rahman, 2012:4078).

The emission costs and data centre energy are concern for Green IT analysis as a result of electrical costs that are being generated (Chawla, 2013:3-6; Ruth, 2009:81; Yunus et al. 2013:241). According to Vykoukal, Wolf and Beck (2009), the energy consumed by data centres is about 30% to 40% for organisations, and this is generated from environmentally hostile technologies. This implies that less attention is given to infrastructural issues including energy consumption, cooling and space for data centres because they are considered unaffordable. In addition, the current energy cost is becoming a major factor for IT managers because data centres account for 25% of total corporate budget, thus affecting profit margins.

This scenario warrants energy efficiency improvements to reduce emission and costs (Chawla, 2013:2; Harmon and Auseklis, 2009:1708; Stansberry, 2013:91).

More energy is wasted by inefficient technologies and below par designed systems. Consequently, this has detrimental effect on the environmental foot print (Jenkin, Webster and McShane, 2011:18). The data centres are expensive on energy costs and wasteful on electricity causing business to be unsustainable (Kurp, 2008:11; Thibodeau, 2008:10; Valanju, 2008:27). According to Campbell, Ratcliffe and Moore (2013:127), the data centres produce 150 million tons of carbon every year across the world becoming major culprits of carbon footprint which requires to be suppressed by organisations. These data centres are driving energy consumption and costs because they consume 80% of the total IT load and account for 23% of carbon emission (Shah, 2012:6; Talebi and Way, 2009). In contrast, Cater-Steel and Tan (2010:112) believe that the power management of data centres is a significant initiative to be energy efficient. Therefore, green process should begin at data centres. However, there is a lack of understanding of Green IT and its applicability causing reluctance for organisations to change (Gartner, 2008).

According to Nishant, Teo and Goh (2012), the reduction of energy consumption means purchasing less electricity. As a result, energy conservation ensures energy saving and costs. Thus, designing servers that conserve energy in proportion to work performed is a necessity to lessen adverse environmental impact (Harmon and Auseklis, 2009:1709-1710). Moreover, the data centre space constraints and energy costs are driving Green IT, because energy cost is increasing among organisations and IT organisations are unable to fund physical expansion of their data centres to add more storage or processing capacity (Data Monitor, 2009:10). In the same light, Ruth (2009:75) affirms that data centre energy and emissions have become a concern in green IT analysis because it generates half of all IT associated costs. As a result, buying new servers that are energy efficient is essential. Conversely, it is important to relocate the physical servers to virtual facilities in data centres to minimise harmful environmental impact (Riaz, Gutierrez and Pedersen, 2009). The data centres using cloud technologies are more efficient in comparison to the traditional data centres, and this has become the key driver for Green IT for organisations because it prolongs the life of data centres by intelligently refreshing all equipments (Dao, Langella and Carbo, 2011:2; Hedman and Henningsson, 2011:55; Mingay, 2007; Uddin and Rahman, 2012:4082).

2.5.2 The effect of data power energy on the environment

Data growth is outstripping the decline in hardware costs and increasing storage spending, with storage now consuming 12 – 15 % of IT budgets, and this data increase could erode strategic IT spending (Tallon and Scannell, 2007:65). The current computers that are used were not engineered to reduce energy consumption, as a result, they consume more power than required during normal operation (Albertson, 2008:6). Therefore, this increased IT power consumption is leading to pollution and related environmental side effects and has become a topic of concern (Talebi and Way, 2009). In line with this concern, IT stresses the need for energy efficiency and reduction of environmental impact through the adoption of Green IT (Cai, Chen and Bose, 2013:493).

2.5.3 The implications of energy cost on the business

The rising cost of energy and environmental awareness have introduced challenges for organisations globally, prompting for searches for efficiency and cost reduction caused by IT (Chawla, 2013:3; Hodges and White, ND). It is important to note that the energy costs resulting from the data centres, servers and coolers are consistently increasing, thus contributing to environmental challenges (Ruth, 2009:83). In general, electrical energy costs over the life of data centre equipments are effectively managed as expenses and electrical power consumption was previously not considered a significant design criterion for data centres over the years (Albertson, 2008:8).

According to Molla and Abareshi (2012:93), Uddin and Rahman (2012:4079), data centre managers remain uninformed of the energy problems relating to IT equipment, which will most likely run the risk of magnifying the energy cost and increasing the carbon footprint over the years. Should the energy costs continue to double every five years, this will substantially increase to 1600% between 2005 and 2025, and so, Bose and Luo (2011:42) note that, to improve flexibility and responsiveness, the IT infrastructure should reduce costs, resolve space, power and cooling constraints that impact growth in IT to achieve Green strategy objectives. Ruth (2009:75) asserts that the data energy and emission expenses are a concern in Green IT analysis from small installations to huge facilities with thousands of servers and tens of thousands of related workstations, because more than half of all IT related electrical costs are created there. In particular, energy costs are becoming a proportion of the cost of running data centres, and corporate demand for data processing and storage capability continues to grow (Molla and Abareshi, 2012:93).

Green computing cost of energy results in the reduction of natural resources, thereby increasing concern for the environment by the general population and sensitivity of interests (Sinha, 2011; Talebi and Way, 2009). It is acknowledged by studies that the rising cost of energy and resource costs are enhancing organisations to adopt Green IT for corporate sustainability (Albertson, 2008:3; Erek, 2011:9; Jenkin, Webster and McShane, 2011:18-19; Kurp, 2008:13; Pollard, 2013:37; Uddin and Rahman, 2012:4079). The underlying reason is that economic opulence is increasing globally and the population is growing, and this implies that there is a rising use of nonrenewal resource and energy (Data Monitor, 2009:10; Harmon and Auseklis, 2009:1709; Hedman and Henningsson, 2011:55; Mingay, 2007; Nishant, Teo and Goh, 2012; Riaz, Gutierrez and Pedersen, 2009; Welfens and Lutz, 2012:155).

2.5.4 The importance of energy saving

Improving energy efficiency will lead to the reduction of pollution, eventually saving money. It is acknowledged that reducing energy consumption and pollution implies going "Green" (Talebi and Way, 2009; Valanju, 2008:26). It is important that organisations should start saving energy and reduce on GHG emissions. This energy saving will translate to financial savings (Hanne, 2011:426). There is strong evidence that suggests that Green IT has the potential to reduce energy usage and bills (Chou, 2013:236; Murugesan, 2008:7; Trimi and Park, 2013:364; Zhang and Liang, 2012:1001).

2.5.5 The effect of energy efficiency

Organizational IT usage contributes to increased energy consumption, eventually causing carbon footprint (Cameron, 2009). However, IT is also playing a significant role in the reduction of emissions, thereby increasing energy efficiency and contributing to sustainable growth (Vereecken et al., 2010). More importantly, IT organisations have understanding about energy efficiency and are unclear about material efficiency, which has a link to climate change (Mingay, 2007; Pollard, 2013:37). In particular, the advanced technology products such as computers, screens and mobile infrastructure have led to an average 30% energy effeciency achievement in three years through the utilisation of environmentally friendly design and development (The Editor, 2009:8). An important factor to note, is that the utilisation of energy management settings is a plan for reducing energy consumption and carbon dioxide emissions, because the management of power is a standard and often an overlooked feature of computers and software on the market (Talebi and Way, 2009).

According to Kurp (2008:13), it is not unusual for companies to replace their older computers with new ones, in order to conserve energy and become more environmentally friendly. In contrast, the use of IT is increasing energy consumption leading to escalated energy costs (Berthon et al., 2010:16). The energy efficiency relates to activities that increase energy security in order to improve the standard of living of the poor and decreasing human impact on the environment. Therefore, energy efficient technology is important to help organisations reach climate goals to reduce environmental impact (Albertson, 2008:8; Borggren et al., 2013:126; Bose and Luo, 2011:42; Khan et al., 2014:336; Talebi and Way, 2009; Vine and Hamrin, 2008:2007:467). Lakshmi, Sarwani and Tuveera (2012:1282) maintain that Green IT is all about efficient use of computers. Mattern, Staake and Weiss (2010) point out that the high hopes rest upon Green IT implementation to reduce energy consumption and contribute to energy savings. Making data centres more energy efficient is a multidimensional challenge because many data centre operators are not conscious of the financial, environmental and infrastructure paybacks to be gained from energy efficiency (Widjaja, Mariani and Imam, 2011).

The implementation of Green IT is the fundamental cornerstone that enhances energy efficiency and substantially decreases GHG emissions through the application of environmental technologies, and is acknowledged as a strategic technology for reengineering of business and reducing environmental footprint for organisations (Erek, 2011:2; Murugesan, 2008:26; Uddin and Rahman, 2012-4079-4092; Waiti and Koo, ND). Green IT is regarded as a social and technical arena for innovation (Murugesan, 2008:25; Rahim and Rahman, 2013:80).

2.6 THE EFFECT OF CORPORATE GOVERNANCE ON THE BUSINESS

Organisations are becoming aware of their responsibilities towards the environment because of their effect of gas emissions, toxic waste materials and increased energy consumption resulting in adverse environmental impact (Borggren et al., 2013:127; Kuo and Dick, 2009:81-82; Shah, 2012:4). In line with this statement, environmental stewardship has emerged over the years to reduce GHG and carbon footprint that eventually results in climate change. As a result, organisations are playing a significant role in the protection of the environment to improve their business performance (Brooks, Wang and Sarker, 2012:16; Butler, 2010:1; Hogan, 2011:12; Lakshmi, Sarwani and Tuveera, 2012:1282; Olson, 2008:22). Environmentally friendly organisations are rewarded by the news of their social obligations and good corporate citizenship (Enterprise Management Associates, 2008:2). This means that organisations are conscious and fascinated in the economic, strategic, regulatory, environmental and social concerns related to the use of IT for sustainable and responsible business (Sarkar and Young, 2009).

The United Nations Environmental Programme (UNEP) is aiming at promoting IT as a critical contributor to sustainable development, thus ensuring corporate social responsibility (Yi and Thomas, 2007). According to Campbell, Ratcliffe and Moore (2013:127) and Molla et al. (2008:670), Corporate Social Responsibility and sustainability are common among businesses today. Strong evidence suggests that organisations are legally, morally and socially required to adopt Green IT because of the benefit it offers to promoting positive corporate image (Murugesan, 2008:25). Similarly, Chen, Boudreau and Watson (2008), are of the opinion that legislation is a fundamental tool for enforcing ecological issues, thereby ensuring organizational compliance and sustainability. The United States has endorsed Green IT to hold companies accountable to reduce carbon emission and energy costs that are causing harm to the environment (Harmon and Auseklis, 2009:1707).

Corporate responsibility and sustainability are becoming urgent for organisations to be more flexible to quickly adapt, and respond to markert changes and fast changing business environment (Dao, Langella and Carbo, 2011:1). This suggests that the organisations have accepted and acknowledged their responsibilities in protecting the environment and contribute to a sustainable environment, thus becoming eco-friendly in order to thrive (Berthon et al., 2010:14; Butler, 2010:1; Hogan, 2011:11; Molla and Abareshi, 2012:93). According to Sinha (2011), organisations aspire to gain competitive advantage and capture market share by mitigating risks and building a competitive advantage. Kuo and Dick (2009:83), assert that the organisation’s corporate social responsibility motivation is based on the sense of commitment, responsibility or compassion rather than self-interest.

Most significantly, organisations are likely to experience improved reputation, trust and competitive advantage through corporate governance (Steenkamp, 2011:3; Thibodeau, 2008:10). In line with this statement, the improvement of corporate governance is receiving attention from different sectors of business and society (Ngoepe and Ngulube, 2013:2). The corporate governance’s primary impetus is to build a synergistic link between workers and the organisation, thereby protecting company interests (Badenhorst, 2009:5). According to Campbell, Ratcliffe and Moore (2013:127), business has the responsibility to address matters such as poverty and health which is known as “Corporate Social Responsibility”. In contrast, Chong et al. (2010:86), assert that it is imperative for organisations to ensure that Green IT is compliant with corporate social responsibility, consequently ensuring that business operations do not violate the law. In this regard, IT governance is perceived to be effective, if it contributes positively to the level of overall corporate governance (Ferguson et al., 2012:76).

The King report indicates nine principles some of which include company responsibility (acceptance of all consequence of organizational behaviour), social responsibility (responding to social issues) and sustainability (reducing the negative environmental and social footprint) in order to decrease the harmful impact on the surroundings and business sustainability (Pretorius, Leonard and Strydom, 2013:63). In contrast, Smith and Perks (2010:2) are of the opinion that the King III report addresses sustainability according to the tripple bottom concept which is economy, social and environmental sustainability to create business value and growth. According to Steenkamp (2011:1), the King Report III (2009) indicates that IT system is an enabler of business, thus the governance of IT is corporate and imperative. It is thus important to note that the King III report on corporate government in South Africa, acknowledges the link between good governance, compliance with law and information management (Ngoepe and Ngulube, 2013:1).

Green IT initiatives will enable organisations to strive in achieving economic viability, thereby improving system performance and use regarding social and ethical responsibility (Bose and Luo, 2011:51; Hedman and Henningsson, 2011:56; Murugesan, 2008; Sinha, 2011; Molla et al., 2008:671; Vykoukal, Wolf and Beck, 2009). In contrast, Kuo and Dick (2009:83) and Thibodeau (2008:10) are of the opinion that competition, legitimation and social responsibility influence Green adoption. The driving force for Green IT adoption by organisations is ethics and concern for the environment (Chong et al., 2010:86; Kuo and Dick, 2009:83; Sinha, 2011). Unfortunately, Green IT adoption in South Africa, seems to be economic, rather than the need to do the correct thing for the environment (Petzer, McGibbon and Brown, 2011:332). Green IT supports cleaner environment and corporations that practise it are likely to improve their bottom line performance (Trimi and Park, 2013:377). Studies indicate that Green IT is an economic and social imperative for sustainable environment (Badenhorst, 2009:7-8; Hanne, 2011:426; Hedman and Henningsson, 2011:56; Murugesan and Molla, 2011:45).

2.6.1 Regulations driving Green Information and Technology

There is lack of legislation restricting the hazardous substance, and as a result, carbon emission remains unregulated and e-waste is growing at an unprecedented rate causing significant adverse impact on the environment (Hanne, 2011:425). According to Chowdhury (2012:634), the Directorate General for Climate Change Action has been established in Europe to advance and implement profitable international and domestic climate change policies in order for the European Union to achieve meet its target of reducing GHG by 2020 and beyond.

On the contrary, Campbell, Ratcliffe and Moore (2013:127) and Tanskanen (2013), point out that The European Union Waste and Electronic Equipment directive enforces legal obligations on the producers, importers and resellers of electronic equipment to dispose of, refurbish and recycle IT equipment in an ecologically sound manner to ensure minimum compliance. However, despite these directives, there is inadequate legislation globally for effective e-waste management in both developed and developing countries (Kiddee, Naidu and Wong, 2013:1238). Nevertheless, IT plays a vital role in the worldwide economy (Paletta and Junior, 2013:62).

The Basel Convention of 1989 has been adopted as the guiding principle that each country should be accountable for its own hazardous waste. The convention implemented a requirement for developing countries wishing to engage in the trade of hazardous waste. Furthermore, the European Commission has implemented a restriction on hazardous substances directive to address the e-Waste dilemma (Billinghurst, 2005:401; Dittke, 2009). This view is shared by Leemans and Solecki (2013:272), who declared that the United Nations Conference on Sustainable Development (Rio+20) in June 2012 acknowledged the negative trends caused in the environment, and initiated the development of sustainable targets. According to Dittke (2009), the Switzerland system uses the ordinance on the return, the tracking back and the disposal of electrical and electronic equipment. The primary impetus of the ordinance is to guarantee that the IT equipment does not enter the municipal refuse stream and that it is discarded in an ecologically friendly fashion. Eventually, a person discarding electrical or electronic equipment shall take it back to a retailer, manufacturer or importer or to a dumping facility. Subsequently, this system is regarded as effective for e-Waste management by different countries.

Dittke (2009) and Fairweather (2011:71) indicate that in 2006, restriction on hazardous substances (RoHS) regulations were executed by the European Union to control new electrical and electronic equipment having more than the agreed levels of lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyl and polybrominated diphenyl ether flame retardants to reduce on environmental pollution. According to Tanskanen (2013:1004), the RoHS Directive requires that heavy metals be replaced by less hazardous substitutes in electronic products in order to minimise the adverse environmental impact of IT operations.

The Kyoto protocol accepted in Kyoto, Japan, has set binding targets for industrialized countries and the European community to decrease GHG emissions to combat climate change. Similarly, the Environmental Protection Agency has suggested mandatory GHG emission rules for organisations that release more than 25,000 metric loads of carbon dioxide and emphasize that it should be reported to the Federal Agency (Chowdhury, 2012:633). The aim of the Kyoto protocol was to decrease the harmful influence of energy emissions on the atmosphere. However, the objective of the Kyoto protocol seems daunting (Khan et al., 2014:337). Boiral (2006:316), further highlights that the purpose of the Kyoto protocol was to control the GHG for the 55 signatory countries, while developing countries have no constraining obligation with respect to the protocol. According to Atkinson et al. (2010:2), Chuang and Huang (2015), the Kyoto Protocol provision is for signatories to take on all legally binding caps of their carbon emission. On the contrary, the Kyoto Protocol does not include the increase of total emissions from established Organisations for Economic Co-operation and Development (OECD) countries because it is not obligatory (Bate, 2005).

The businesses are establishing new ways to improve their competitiveness and comply with environmental regulations, thereby addressing environmental concerns and reducing environmental impact caused by their products and service activities (Smith and Perks, 2010:2). The theory underpinning these new ways' establishment is because IT organisations are facing exclusion from major markets if their product does not comply and conform to the environmental regulations (Butler, 2010:2). Thus, organisations are under constant pressure of green and regulatory movements to reduce their footprint for corporate social responsibility (Viaro and Vaccaro, 2010:3). It is important that organisations should create environmental management systems to monitor their operations and reduce their carbon footprints (Chou and Chou, 2012:447).

Developed countries set up realistic GHG emission reduction targets to control climate change following the Kyoto Protocol in 1997, The United Nations Climate Change Conference in Bali 2007, G8 Summit in Italy 2009, and Copenhagen Commitment in 2009. However, this reduction goal seems daunting (Ng, Chen and Wong, 2013:131). Consequently, organisations are motivated and sometimes forced through laws and regulations to be environmentally responsive (Cai, Chen and Bose, 2013:491). On the other hand, Chou (2013:231-235) puts it into perspective that, in order to conserve energy, reduce GHG emissions and waste disposal, it is important for organisations to comply with environmental regulations, thus creating the hope of reaching environmental sustainability.

Green IT enables organisations to prepare for future legislation and regulations that will benefit the organisation, employees and the environment through recycling and decreasing hazardous waste that affects the climate and natural resources (Chou, 2013:231-235; Molla, 2009; Sinha, 2011; Uddin and Rahman, 2012:4082). According to Unhelkar (2011:57), Green IT improves the processes and applies standards such as ISO 14001 in the entire areas of business to serve as the basis for environmental management systems. In contrast, Dittke (2009) affirms that South Africa does not have a devoted legislation dealing with e-Waste unlike other countries. However, this does not suggest that hazardous substances or waste management is not regulated, but e-Waste exacerbates and complicates the regulation of these hazardous substances. As a result, South Africa needs to respond and address the evolving issue of e-waste through the development of new regulations (The Advanced Tropical Environment, 2012:14).

In terms of the Constitution of the Republic of South Africa (108 of 1996) Section 24 of the Constitution's Bill of Rights, everyone has the right to:

"an environment that is not harmful to health or wellbeing, and
have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that prevent pollution and ecological degradation, promote conservation, and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development ".

The National Environmental Management Act (107 of 1998) Section 24 does not deal with waste management in great detail, however the Act states that waste should be avoided, or where it cannot be avoided altogether it should be minimized and reused or recycled where possible, and otherwise disposed of in a responsible manner. The National Water Act (36 of 1998) Section 1, defines waste as "any solid material that is suspended, dissolved or transported in water (including sediment) and which is spilled or deposited on land or into a water resource in such volume, composition or manner as to cause, or to be reasonably likely to cause, the water resource to be polluted". On the other hand, the Health Act (63 of 1977) Section 20, requires the local authorities to carry out all lawful, necessary and reasonably practicable measures to maintain their district in a hygienic and clean condition, prevent the occurrence of any nuisance, unhygienic or offensive condition, or any other condition which could be harmful or dangerous to the health of people, and prevent pollution of water intended for human use. In addition, the Occupational Health and Safety Act (85 of 1993) and its regulations (Lead regulation 17 and Hazardous regulation 15) require the business (employer) to recycle lead or hazardous waste, or otherwise dispose of it in a safe and lawful fashion.

2.6.2 The effects of sustainable development and environmental sustainability

Ecological sustainability is a solution to environmental and social problems because the natural environment is deteriorating in unrecoverable manner from the growing impact of human economic activity (Chen, Boudreau and Watson, 2008; Jenkin, Webster and McShane, 2011:17). The concept "environmental sustainability" is currently a global concern (Chou, 2013:231). Harmon and Auseklis (2009:1701-1712) explain that sustainable IT is everything that an organisation needs to do in ensuring that IT services deliver a superior value in order to attain market position and the ability to survive. Consequently, sustainable IT has become the driver for energy saving and innovation. Eco-sustainability considers averting contamination at the end of a product use, thereby reducing environmental footprint using clean technologies and developing friendly competencies (Molla, 2009).

According to Vesilind, Heine and Hendry (2006:23), the corporations have to start practicing green technology, if they want to move towards sustainability. In contrast, Chow and Chen (2009:136) believe that the approach to accomplishing sustainability of a green environment should include social responsibility, environmental protection and economic progress. In general, organisations are focusing on sustainability because of economic opportunity to strengthen their reputation, improve employee morale, save on cost and prevent pollution and adverse environmental issues (Smith and Perks, 2010:2).

The growing IT sector is posing a threat to sustainable development because of the inevitable amount of obsolete, discarded, broken or abandoned IT products resulting in toxic waste. Most of these obsolete and discarded IT products are exported to developing countries for repairs and reuse (Osibanjo and Nnorom, 2007:492). Unfortunately, there is a concern surrounding both wealth and the disparity of natural resource depletion causing organisations to be unsustainable (Dao, Langella and Carbo, 2011:1; Erek, 2011:4). In principle, sustainable organisations contribute to sustainable developments by bringing forth economic, social and environmental outcomes which are known as pillars of sustainable development (Chuang and Huang, 2015; Viaro and Vaccaro, 2010:2). According to Chowdhury (2012:633), sustainable development is an agenda for the United Nations and can be achieved through suitable combination of economic, environmental and social development undertakings. Sustainable development is a political idea that originated from the Brundtland report issued by the World Commission on Environment and Development which aimed at economic development (Hilty et al., 2006:28). Accordingly, IT has become an enabler and a catalyst for providing a sustained economic development (Roztocki and Weistroffer, 2011:163).

The rapidly growing IT sector is posing a threat to sustainable development (Osibanjo and Nnorom, 2007:492). Chuang and Huang (2015) iterate that the growing awareness of sustainable development and the adoption of Green IT is a subject of concern across the world for environmental protection. Sustainability has recently become a norm which is the capacity to endure and maintain long term wellbeing for humans and is thus an important concept to grasp (Chou and Chou, 2012:447). In line with this concern, sustainability should be delivered by organisations to reduce the effect of GHG emissions and environmental impact (Campbell, Ratcliffe and Moore, 2013:127). Sustainably managed IT contributes to the reduction of environmental concerns (Korte, Lee and Fung, 2012:3; Nishant, Teo and Goh, 2012).

Environmental issues have become a global concern (Chou, 2013:231; Gupta et al., 2013:8; Rogers et al., 2013:974). More importantly, environmental sustainability is the solution to environmental degradation (Rahim and Rahman, 2013:241; Waiti and Koo, ND). As pointed out by Elliot (2013:270), organisations have important roles to play in achieving environmental sustainability through the changing of pollution practices and enabling solutions. According to Saha (2014), sustainable computing assessment should be bench marked against best practices of organisations utilizing the following areas: productivity, reuse, accountability, energy and environmental social responsibility. The challenges for conventional economics are the result of the transition to a sustainable society (Devarajan et al., 2009:101). In a broader sense, economic sustainability involves analysis to minimise social costs of meeting standards for protecting the environment and determining the standards (Morelli, 2013:2).

Organisations are moving towards Green IT to experience a business environment that is friendly, sustainable and cost effective (Uddin and Rahman, 2012:4079-4081). As such, Green IT is regarded as the orderly submission of environmental sustainability criteria such as the design, production, sourcing, use and disposal of the IT technical infrastructure (Molla, 2009). In practice, Green IT adoption has been pledged to meet the quest for environmental sustainability through the provision of analytical tools for carbon foot print count (Andreopoulou, 2012:7; Chou and Chou, 2012:447; Gartner, 2008; Vesilind, Heine and Hendy , 2006:22).

2.7 THE EFFECTS OF GREEN IT STRATEGIES ON BUSINESSES

Organisations have not realized the impact of climate change in order to aggressively tackle it through the development of Green IT strategy (Mingay, 2007). The literature review suggests that a holistic and all-inclusive Green IT strategy should be developed by organisations to minimise the negative impacts of the ecosystem (Cai, Chen and Bose, 2013:493; Murugesan, 2008:31). The fundamental IT strategy should be aligned with the business strategy to improve organizational competitiveness and managing environmental aspects (Erek, 2011:2; Olson, 2008:22). According to Hodges and White (ND), to develop Green IT strategy that identifies opportunities for greater efficiency can be difficult without visibility and transparency into the state of the existing IT infrastructure. Therefore, IT should form a core element for any organization’s green strategy.

Organisations are aggressively pursuing Green IT strategies to reduce the costs because of the global economic downturn (Data Monitor, 2009). They have realized that overlooking the adverse impact on the atmosphere will be costly in the future, as a result, they are incorporating green into their business strategy to achieve cost efficiency, reduction of carbon footprint and improvement of branding and images (Chong et al., 2010:87; Smith and Perks, 2010:3). In order for organisations to implement Green IT, they should have strategic plans and visions on green that are based on long term goals for business to gain competitive advantage through the reduction of IT operational cost leading to environmental sustainability (Campbell, Ratcliffe and Moore, 2013:132; Chong et al., 2010:84; Enterprise Management Associates, 2008:3-4; Mingay, 2007; Mojsilovic et al., 2007:3610; Murugesan and Molla, 2011:41; Smith and Perks, 2010:3; Rogers et al., 2013:975; Uddin and Rahman, 2012:4078). Accordingly, the companies that redesign strategies are likely to strengthen their brand through showcasing their initiatives and providing business opportunities (Hedman and Henningsson, 2011:56). The strategy for green growth lies at the heart of good economic policy portrayed as a means to alleviate poverty (Borel-Saladin and Turok, 2013: 212).

Environmental strategies signify the IT precise elements of the general environment strategy and resulting technologies and systems (Jenkin, Webster and McShane, 2011:22). In view of the literature, developing an overall Green IT strategy that identifies opportunities for greater efficiency would benefit from new technology which will improve processes that may be difficult to achieve in Green IT value (Hodges, 2004). In contrast, Hasbrouck and Woodruff (2008:39) are of the opinion that technology has a complex relationship with environmental issues. However, it is also part of the solution to advance environmental sustainability, quality of life and economic growth. In effect, Green strategy can be developed by engaging stakeholders, conducting audit and review of equipment purchases, disposal policies and practices, reducing carbon footprint, energizing the workforce and monitoring and outlining tangible and intangible benefits, then revising the strategy (Bose and Luo, 2011:42; Chou, 2013:236, Hasbrouck and Woodruff, 2008:39; Molla and Abareshi, 2012:93; Murugesan and Molla, 2011:46).

2.7.1 The influence of green economy

Sustainable business and green economics can be created by technology (Uddin and Rahman, 2012:4078). In practice, IT is enabling technology to have an impact on all sectors of life because it has the potential for accomplishing green economic long term growth and universal sustainability (Robinson, 2010:53; Welfens and Lutz, 2012:156). Zhang and Liang (2012:998), point out that IT is identified as one of the key driving sectors in creating green economy. Therefore, it is a major driver for organisations to implement Green IT measures (Erek et al., 2011:4). According to UNEP (2011) green economy consists of national regulations, policies and motivations as well as international market and legal infrastructure, trade and technical assistance. Green economy refers to economic growth that does not necessarily lead to ecological deprivation but the improvement of the environment (Borel-Saladin and Turok, 2013:211-213).

The studies reveal that green economy has the potential for growth and ability to create jobs and alleviate poverty (Borel-Saladin and Turok, 2013:211-212; Hamdouch and Depret, 2010:474). The emergence of green economy in organisations has the opportunity to bring about financial growth and moral renewal. However, there is little research on how green economy impacts strategy, structure and culture of today's organisations (Green and McCann, 2011:446-461). In this regard, the new sectors of the green economy have accelerated their growth globally because of the effects of climate change (Henderson, 2007:276). Green economy is described as the pathway to improve the environment and decrease destructive practices towards sustainability (Borel-Saladin and Turok, 2013:211; Eaton, 2013:62-63).

2.7.2 The impact of green design

Green design means the designing of efficient and ecologically sound computers, servers, cooling equipment and data centres (Chong et al., 2010:84; Chou and Chou, 2012:448; Murugesan, 2008:26; 2010:4; Vykoukal, Wolf and Beck, 2009). However, Adhikary (2008:22) sees such a design for green as a major factor in achieving Green objectives despite the design systems having constraints. In this regard, organisations are focusing on energy efficiency methods throughout the manufacturing of IT products (Brooks, Wang and Sarker, 2012:34; Lakshmi, Sarwani and Tuveera, 2012:1283). In general, Green IT has evolved as the design and execution of information systems that contribute to ecological business processes and create environmentally sustainable society (Chaudhuri et al., 2008; Rahim and Rahman, 2013:241; Seidel and Recker, 2011). Accordingly, the design of Green IT is becoming a necessary practice and intended to reduce the environmental impact of computers through the adoption of new technologies (Chou, 2013:231; Chou and Chou, 2012:448; Murugesan, 2008:30). Green IT should be designed to minimise GHG emission throughout IT life cycle from gratified creation to distribution, access, use, handling and disposal (Chowdhury, 2012:635).

2.7.3 Information and Technology life cycle management

Many studies suggest that information systems should be studied from conceptualization to development throughout the operations, in order to acquire deep understanding of IT management practices (Berghout, Nijland and Powell, 2011:755). According to Canadian International Development Agency (2010:3), IT life cycle management promotes stewardship and value for money. In line with this statement, IT life cycle is taking into consideration material extraction, production, and use, transport and end life cycle of the IT product. Subsequently, it is important to consider these elements when determining green technology and environmental impact (Vereecken et al., 2010).

Green IT objectives spread to the IT product's usage over its life cycle and eventually resulting in recycling, reuse, and biodegradability of outdated products (Harmon and Auseklis, 2009:1708). In contrast, many organisations approach the management of IT in an unstructured manner through its life cycle. IT project life cycle should comprise project selection, strategic implementation and performance evaluation (Steward, ND). As a result, the intention of Green IT is the achievement of economic viability through improved IT system performance with emphasis on re-use, refurbishing and recycling and end of life management for environmental sustainability (Chong et al., 2010:85; Mayers et al., 2002:357; Salmani and Sharifian, ND).

Green IT should be included in the phases of IT product life cycle such as development, production, usage and disposal phase to attain substantial reduction of carbon emissions and save cost (Widjaja, Mariani and Imam, 2011). The longer the IT product lasts, the lesser the impact on the environment due to disposal, therefore the extension of IT product life is a significant green influence on the IT life cycle (Chakravarthy, Kumar and Ragav, 2013:1). However, the challenges faced by organisations in the computing environment include reduction of costs, increasing productivity of professionals of information and reducing the complexity of IT (Paletta and Junior, 2013:70). In practice, computer's life stages (from production, use and disposal) present environmental problems (Murugesan et al., 2013:16).

2.7.4 The best practices on Information and Technology

Ecologically comprehensive IT products should not be hazardous to the health of people or animals, nor cause any damage to the environment during manufacture, use or disposal, nor lead to consuming energy, nor unnecessary waste due to short life span (Moisander, 2007:405). In view of the above concern, efficient IT is equal to Green IT, which is genuine beneficial by-product of the primary goal that delivers the right amount of IT at the right time. Moreover, ISO 14001 provides a guideline to manage environmental footprint, consequently resulting in the best practice for Green IT programmes (Gabriel, 2008:232).

2.8 CRITICAL REVIEW OF THE LITERATURE STUDIES

A review of the literature on GHG emissions discusses IT and its implication on the environment. The current high level of energy consumption is contributing to GHG, which is the main cause of climate change (Bate, 2005; Borggren et al., 2013:126). However, they do not state measures that should be taken to address these GHG emissions. According to Principe (2014), if humans continue to pump extra carbon dioxide into the atmosphere, this will cause an imbalance in GHG emissions effect and eventually this will affect the weather patterns. Scientists suggest that global warming beyond 2˚C carries the risk of irreversible harm to human wellbeing and development prospects across all countries. They warn that the earth's climate is on track for 4˚C of warming, and this scenario is linked to greater hunger, species loss and homelessness caused by rising sea levels (Principe, 2014). However, experts propose that there is no scientifically binding mechanism for carbon dioxide causing climate change because the global temperatures have always been changing despite carbon increases. They state that the earth is much older than the human race and has never been static (Roosa and Jhaveri, 2009). There are different views on the scientific stance of climate change and scientists are vigorously disapproving scientific discoveries about it. Therefore, the debate about climate change is futile and action should be taken rather than debate about its existence (Principe, 2014).

The aftermath of carbon emission is significantly high because of computer electricity usage. Evidence suggests that GHG emissions in the atmosphere absorb and emit radiation which is a fundamental process that causes the greenhouse effect (Harmon and Auseklis, 2009:1709; Huang, 2009:115). Carbon emission is one of the heaviest gas molecules in the atmosphere which stays low, hugging the grounds and allowing the plants to photosynthesize and its biggest problem is that it is getting higher into the atmosphere thereby creating GHG emission effects. The climatologists indicate that the planet has cooled by 0.7 degrees. Therefore, they are of the opinion that there is no scientifically binding mechanism for carbon causing global warming. They believe that the public is being deceived through propaganda. According to them, there is no compelling evidence that the observed warming is caused by man (Evans, 2017). On the other hand, scientists doubt the effects of carbon dioxide on how bad it is predicted because it’s minor GHG emission. Unfortunately, the burden of proof is with those who think the changes are caused by natural causes. Scientists argue that since the effects of increased carbon dioxide on the environment is unknown, action is required to limit the emission until its effect is better understood. Therefore, the time of inaction has passed and the time of initiative is upon businesses (Christy, Norris and McNider, 2009). Green IT adoption is perceived to be the ultimate solution (Bose and Luo, 2011:39; Butler, 2010:2; Mattern, Staake and Weiss, 2010).

In view of the need for carbon reduction, the author discusses the implication of carbon and the importance of its reduction (Boiral, 2006:326; Murugesan, 2008:25). Research indicates that during the past century the pace of warming has accelerated. Eventually, new environmental problems have surfaced that emphasize the ultimate fragility of the planet’s ecosystems. Finding a solution to reduce carbon emission cannot be understated. Experts believe that no matter what action is taken today, the consequences of increasing carbon levels will continue to plague the earth for generations to come. Therefore, the time has come for organisations to refocus their resources towards finding solutions that will reduce or eliminate carbon emissions (Roosa and Jhaveri, 2009).

A review of the environmental impact indicates major environmental issues that include climate change, pollution, environmental deprivation and resource depletion. IT equipment has the potential impact on the environment because of its increased energy consumption and inappropriate disposal of e-Waste. This phenomenon of environmental impact is recognized because the ozone layer cannot be repaired once the damage is done (Childs, 2008; Korte, Lee and Fung, 2012:2). The challenge for IT is whether it should continue to evolve naturally within business or it should become an active enabler of change for the organisations to drive down emissions and reduce the ecological impact of business operations. Many organisations have incorporated a Green IT agenda, but are often constrained to the traditional IT environment. As a result, every single effort should be put in place to reduce this evil beast called carbon by utilizing green technologies (Campbell, Ratcliffe and Moore, 2013:127; Chowdhury, 2012:639).

A review of the ecological issues discloses ecological crises that are caused by IT and eventually contribute to irreversible changes of the climate (Hanne, 2011:424; Shuanggui, Jing and Shiyuan, 2011:253). Technology is a major contributor to greenhouse gases and environmental pressures. However, technology offers the potential to save the planet if it is used and designed responsibly (Roosa and Jhaveri, 2009). While each organisation has accepted varying degrees of technology to drive green programme, they have failed to adopt large-scale implementation of these initiatives. Organisations have often failed to identify the role that IT can play in implementing and optimizing these initiatives. Consequently, limited research currently exists on the benefits of driving IT for business innovation (NASA, 2014). In contrast to these views, the preventative measures of ecological change are desperately needed to avert catastrophic climate change (Tomlinson, 2010:2-3; Viaro and Vaccaro, 2010:2).

A review of climate change discusses how it affects the planet in a variety of ways (Charnoviz, 2012:45; Nishant, Teo and Goh, 2012; Wunsch, Schmitt and Baker, 2013). The primary disadvantage of GHG is the disruption they cause to the ecosystem. Clouds and cloudiness are the main aspects in the earth's climate change. According to experts, clouds rule the earth's climate, and everything else including the atmospheric greenhouse gas gases is marginal. Anthropogenic effects on climate change are accepted by more than 99% of climate scientists

(NASA, 2014). However, there is a debate concerning climate change on whether it is actually happening or not. The other side of the climate change argument is that the earth went through drastic temperature fluctuations in different periods of time. Therefore, scientists believe that claims made about the effects of climate change are exaggerated (Beluz, Plumer and Resnick, 2016).

Climatologists are of the opinion that temperature records have been manipulated to affect the overall picture of rising temperatures (Beluz, Plumer and Resnick, 2016). The relentless focus by scientists suggests that climate change is political imperative rather than scientific. According to them, it is hard to avoid the impression that the public is being told less than unvarnished truth. They believe that man-made climate change is a scam and alarmists are making false predictions to create hysteria and bring about carbon taxes (Bourke, 2014). In contrast, scientists suggest that the Kyoto protocol aimed at reducing GHG is believed to be responsible for the regular rise in the earth's average temperature. It is very difficult for the scientists and researchers to model and predict the onslaught of global climate change due to increasing carbon emissions because of the complexity of earth's climate and ecosystems. Therefore, finding ways to significantly slow the onslaught of global climate change is an important task for organisations, governments and decision makers around the world (Roosa and Jhaveri, 2009:2).

A review on hazardous raw materials discusses the contents of e-Waste that contribute to environmental pollution (Bates, Mbeng and Phillips, 2008:210; Osibanjo and Nnorom, 2007:494-500). The heavy metals and other toxins can leach into the soil from landfills and evaporate into the air and enter it through incineration (Binns et al., 2006:5). The Basel Convention developed an amendment to ban the export of hazardous waste for disposal to the developing countries. Notably, countries like China have banned the import of e-waste, however, significant volumes are still entering the country illegally (Schiffman, 2015). There is an argument about the exact type and level of risk involved with each computer substance. Furthermore, there is slight doubt amongst experts regarding these hazardous chemicals causing significant harm if they are disposed of properly (Binns et al., 2006:19). It is estimated that less than 10% of e-waste produced is reused or recycled. This means that the majority of the e-waste is inappropriately disposed of in landfills (Siddiqui, 2013; Sthiannopkao and Wong, 2013:1148). Research studies suggest that some computers are intentionally designed for short life cycles and use materials and processes that obstruct recycling efforts with the objective of requiring consumers/organisations to purchase new products (Binns et al., 2006:10).

A review on IT waste disposal discusses the implication of IT gadgets posing environmental problems during production and disposal (Begum, 2013:47; Murugesan and Molla, 2011:40). It is interesting to note that a universal definition of e-waste does not currently exist in determining what qualifies as e-waste which is a point of contention. While scientists generally believe that humans are exposed to dangerous chemicals by e-waste placed in landfills, they are of the opinion that more research is needed to fully understand human exposure of the toxins in e-waste that are leaving land sites and the quantities of toxins humans are exposed to (Roosa and Jhaveri, 2009). Research studies indicate that many organisations do not have convenient access to recycling. Unrestrained burning, disassembly and disposal of e-Waste cause a range of environmental and health problems (Gaidajis Angelakoglou and Aktsoglou, 2010:197). E-waste recycling leaves many unresolved questions related to human exposure to toxins during recycling. It is uncertain whether e-waste recycling practices eliminate all human exposure to e-waste toxins and the exposure rate is unknown. Research reveals that people dismantling e-waste show significantly higher levels of brominated flame retardants in their blood. However, scientific controversy exists about how to evaluate recycling methods that are most beneficial for preventing adverse health effects. Limited evidence currently exists demonstrating the method by which modern landfills leak into the environment. Scientists debate the risk posed to humans by disposing of e-waste in landfills (Binns et al., 2006:19). Therefore, disposed e-Waste should be reused/recycled and managed with caution because it involves significant risks (Kahhat and Williams, 2009:43; Smith, 2004:266).

A review on data centres discusses their impact on business costs (Chawla, 2013:3-6; Ruth, 2009:81; Yunus et al. 2013:241). The escalating energy consumption caused by expansion of data centres is gradually increasing to run the IT infrastructure resulting in environmental concerns (Harmon and Auseklis, 2009:1707; Khan et al., 2014:337). Unfortunately, a lot of power used by IT is simply wasted because many servers are not doing any useful work and still use 60% of their maximum power load when they idle (Li, 2017:20-23). While energy prices is growing internationally, the operational cost of data centres continue to rise gradually (Murugesan, 2008:28). In this regard, IT managers should have ecological concerns at the top of their plan in purchasing and disposal of IT equipments, and help their organisations to be more environmentally aware in their use of technology (Li, 2017:20-23). In the end, designing servers that conserve energy in proportion to work performed implies the adoption of Green IT (Dao, Langella and Carbo, 2011:2; Hedman and Henningsson, 2011:55; Mingay, 2007).

A review on energy savings discusses the principle of saving energy resulting in financial savings (Hanne, 2011:426, Talebi and Way, 2009; Valanju, 2008:26). IT can contribute to major energy saving and help organisations save money, comply with corporate strategy and meet sustainable targets. In this regard, there is a growing body of evidence that suggests that IT organisations can green up their energy procurement and recycling practices. Changing the traditional way in which organisations do business and utilizing IT can benefit the environment. However, the cost reduction in energy savings increased by going green is not always enough to counterbalance the initial upfront exchange costs (Silvis, 2015). In general, IT can assist in driving more efficient and greener processes thereby generating substantial saving (Chou, 2013:236; Murugesan, 2008:7).

A review of energy efficiency discusses the implications of energy bills (Talebi and Way, 2009; The Editor, 2009:8). There is a renewal energy deliberation about the constraint and opportunities linked with the use of renewable energy. Renewable electricity production, from sources such as wind power and solar power is sometimes criticized for being inconstant or irregular despite the market for renewable energy technologies continuing to grow. A fresh approach on IT and power is needed and organisations should be proactive to find ways to become more energy efficient in order to reduce carbon foot print (Mattern, Staake and Weiss, 2010; Widjaja, Mariani and Imam, 2011).

A review on corporate governance discusses the accountability of organisations in terms of economic, social and environmental responsibilities in order to maximize business return (Borggren et al., 2013:127; Shah, 2012:4). It is important to note that corporate governance is a journey, not a destination (Steenkamp, 2011:3; Thibodeau, 2008:10). The Kyoto Summit brought 160 nations together in an effort to reduce carbon emissions and device ways to mitigate climate change. However, at Kyoto the success of the negotiations depended on the individual nation’s willingness to comply with the treaty (Petzer, McGibbon and Brown, 2011:332). Research studies reveal that skepticism is rising that an agreement will be reached on global climate treaty to replace the Kyoto Protocol (Schiffman, 2015). The bottom line is that the result of the Kyoto Protocol has been mixed and in most cases ineffective (Roosa and Jhaveri, 2009:38). Furthermore, the Kyoto Protocol has its critics that it is a socialist scheme designed to suck money out of rich countries. Therefore, its compliance has had the opposite effect because its recommendations are not mandated by law. Therefore, there is a need for stricter environmental regulations to improve corporate image (Chong et al., 2010:86; Ferguson et al., 2012:76).

A review on regulations driving Green IT discusses the adequacy of legislations in addressing environmental harm caused by hazardous substances (Hanne, 2011:425; Chowdhury, 2012:634; Tanskanen, 2013). E-waste exacerbates and complicates the regulation of hazardous substances to combat climate change (Viaro and Vaccaro, 2010:3; Dittke, 2009). The regulation driving Green IT is inadequately enforced and is presenting a challenge including the Kyoto protocol. As a result, the developing countries have become a dumping ground of e-Waste because of the lack of legislation. Businesses should dispose or recycle e-Waste in a safe and lawful manner. In order to respond to the emerging issues of e-waste the development of new regulations and Green IT implementation is essential (Dittke, 2009).

A review on sustainable development and environmental sustainability discusses the implications of the deteriorating environment (Chen, Boudreau and Watson, 2008; Jenkin, Webster and McShane, 2011:17). The argument is that sustainability is the key to prevent or reduce the effect of ecological issues (Vesilind, Heine and Hendry, 2006:23). Creating a sustainable business does not only benefit the planet, but also impacts people and local communities where business is conducted (Gartner, 2008). Despite the increased popularity of the use of environmental sustainability, it continues to be questioned in light of the environmental degradation and climate change (Rahim and Rahman, 2013:241). The immediate and long term impact of environmental sustainability is economic growth which is a solution to environmental and social problems through Green IT adoption (Andreopoulou, 2012:7; Chou and Chou, 2012:447; Gartner, 2008).

A review on green economy discusses the implications that can be created by technology (Uddin and Rahman, 2012:4078). The argument is that green economy improves human wellbeing and social equity, while considerably reducing environmental threats and environmental shortages (Robinson, 2010:53; Welfens and Lutz, 2012:156). However, it is believed that it does not favour political viewpoint but works to minimise disproportionate depletion of natural capital (Borel-Saladin and Turok, 2013:211; Eaton, 2013:62-63). Green economy is complex in terms of policy prescriptions especially the subject of universal negotiations. Despite the green economy evolving as an important concept, it is also controversial. There is no scientific agreement on how to achieve a green economy, nor is there an international agreement on what it means and how to move towards it. The developing countries want green economy concept to be placed within the sustainable development framework of the Rio Summit and not to replace it. While experts acknowledge the positive aspects of developing the green economy concept they also point to related risks (Khor, 2012).

Green economy utilizes one size fits all approach by treating all countries in the same manner and this may lead to failures either for the environment, development or both. It is also inappropriately used by countries for trade protection purposes particularly rich countries to justify unilateral trade measures against the products of developing countries, or to impose standards that have not been agreed upon. Inadvertently, this pressurizes the affected developing countries to take on one dimensional environmental measures rather than sustainable development policies. However, there is a current debate on these issues, of which many believe that the environmental crisis is a result of market failures, which have generated resource depletion, pollution and environmental crisis (Khor, 2012). In general, green economy has the potential to reduce carbon emissions, enhancing energy and resources efficiency (Robinson, 2010:53; Welfens and Lutz, 2012:156).

The objective of Green IT is to decrease the use of hazardous materials, maximize energy efficiency during the product's life time and promote the recyclability or biodegradability of defunct product and factory waste (Victor, 2017). Saving energy and resources can actually save organisation's money in the long run (Buckby, 2008). The theory is that if every organisation were to go green, it would have a significant and noticeable impact, but not every organisation can be convinced to go green and many believe that doing so has no real impact outside of the economics. This makes going green a personal choice for many organisations, which does not necessarily result in concrete economic or environmental benefits (Shawkat, 2016). Furthermore, much of the technology associated with green living provides benefits to the environment but often at a much higher cost (Lake, 2014). On the contrary, some computers that are green are considerably underpowered. Studies indicate that some organisations may need incredibly power consuming and powerful computers to deal with their specific tasks. As a result, this is another disadvantage on high-powered computers in comparison with green computers (Buckby, 2008). Another potential disadvantage of going green is the time factor because the adoption of green life style can often be time consuming for organisations committed to green living (Lake, 2014). Investors and consumers are beginning to request more disclosures from companies with regard to their carbon footprint as well as their environmental initiatives and attainments. They have started discounting share prices of companies that poorly address the environmental problems they create. As a result, many businesses have begun showing their environmental credentials (Murugesan, 2008:26). Going green can be an attractive goal to gain goodwill and consumer support, but unless green improvements are economically viable, it can put a business at a competitive disadvantage (Shawkat, 2016).

2.9 RESEARCH QUESTIONS

The main purpose of the study was to develop a framework for Green IT implementation for South African organisations, in order to overcome the negative IT challenges. These aims seek to provide answers to the following questions:

- What methods of technology can be used to reduce pollution and contribute to the optimal use of renewable energy?
- What method can be used to reduce energy consumption as a result of green technology?
- What approach can be used in the design, production, operation and disposal of IT products in a manner that is not harmful to the environment?
- What strategies can be used to help IT contribute to environmental solutions?
- What sources can be used to determine the impact of adoption of strategic Green IT towards creating a sustainable environment?

2.10 CHAPTER SUMMARY AND CONCLUSION

This literature review in general discussed the contemporary ideas of Green IT implementation by organisations, to establish the way in which the thesis builds upon recent research, to critically determine the approach for succesful implementation of Green IT in South African organisations. The primary purpose of the study was to investigate how Green IT is implemented by South African organisations and develop a framework to ensure succesful Green IT implementation. This was motivated by the relative lack of succesful Green IT implementation/framework in ensuring succesful implementation of Green IT for South African organisations.

Green IT implementation is regarded as a catalyst for the creation of green jobs and facilitating technology transfer which represents an effective tool for low carbon and sustainable development (Semine, 2009). As a result, organisations are moving towards Green IT implementation to make their business cost effective and sustainable (Uddin and Rahman, 2012:4078). The organisations have realized that ignoring the negative impact of IT on the environment will be costly in the future. Therefore, they are developing new ways of enhancing their competitiveness and complying with environmental regulations to address environmental concerns caused by their products and service activities (Smith and Perks, 2010:2-3). The greatest concern in South Africa is the lack of awareness about e-waste and its impact resulting in unsustainable trajectory of atmospheric concentrations affecting the community (Holmner and Marais, 2013:147). Accordingly, organisations are legally, ethically and socially required to adopt Green IT because of the benefits it offers to the environment (Murugesan, 2008:25). Green economy is described as the conduit to improve the environment and decrease harmful practices towards sustainability of the principles of economic growth (Borel-Saladin and Turok, 2013:211).

This chapter discussed the rationale for developing a framework for Green IT implementation among South African organisations, in order to create new fetile ground for innovation, economic prosperity and preserving the environment. In Chapter 3 the Research Methodology followed in this study is discussed, including the population and sample size. The detailed account of both data collection techniques and data analysis and interpretation are presented. Issues of the validity and reliability of the study are discussed. Ethical issues are also discussed and limitations on the research are clarified.

CHAPTER 3: DATA ANALYSIS AND RESULTS

3.1 INTRODUCTION

In the previous chapter a systematic literature review was provided to assess previous studies in line with existing data to pose a question or proposal for the current research. The study presented an overview examination to direct the theoretical foundation of the study, based on a selection of certain keywords from the problem statement in order to design a sound research methodology for the chosen problem, with the view of understanding the essential research methods of what is studied and how it is studied.

This chapter discusses the research methodology and the research philosophy which underpin this thesis. In the previous chapter, the research stated five questions that remained unanswered from the literature review. Research methodology, according to Brynard and Hanekom (2006:35), is the "how" of collecting and processing data within the framework of the research process. This notion is supported by Nicholls (2009) who explains that research methodologies are a specific and principled approach that assist in developing a theory and creating a pathway of how research should or ought to proceed given the nature of the subject it pursues to address.

This chapter defines the research methodology that was used in this study to give answers to raised questions. The research interviews were used in this study to provide answers to the research questions developed in Chapter 2. The research questions ask about the method of technology that can be used to reduce pollution and contribute to optimal use of renewal energy, methods that can be used to reduce energy consumption as a result of green technology, the approach that can be used in the design, production, operational and disposal of IT products in a manner that is not harmful to the environment, the strategies that can be used to help IT contribute to environmental solutions and the sources that can be used to determine the impact of adoption of strategic Green IT towards creating a sustainable environment.

The aim of this study was to develop a framework for Green IT implementation in South African organisations and demonstrate the benefits of adopting Green IT. To validate this, it was necessary to collect information from targeted population using correct methodology and analyse the response. This chapter begins with an introduction of the research methodology that is applied in this research. This is followed by research design, types of research, population and sampling size, data collection method, validity and reliability, elimination of bias, ethical issues, limitation of the study and conclusion.

In a nutshell, this chapter defines the research methodology used in this study, the data collection method that was chosen, types of questions that were asked and development of interview questions, the population and sample size determination, data handling and concludes with the discussion of the researcher compliance with research ethics. The next chapter provides a presentation of findings, comprehensive discussion, interpretation and statistical analysis of the data from the research methodology.

3.2 PHILOSOPHY PARADIGM (QUALITATIVE)

The essence of research begins with a problem and unanswered question (Leedy and Ormrod, 2015:20).

3.2.1 Exploratory research

An exploratory study is a valuable means of finding out what is happening, to seek new insight, to ask questions and to evaluate phenomena in a new light. It addresses the "what" question. It is important to note that everything about the topic is potentially important. However, the steps are not well defined and the direction of inquiry changes frequently. The result of the study conducted by Saunders, Lewis and Thornhill (2007:133) indicates that there are three primary ways of conducting exploratory research which include: a search of the literature, interviewing experts in the subject and conducting focus group interviews. In line with these findings, exploratory researchers have been labelled by Neuman (1997:19) as being original, open minded and flexible to embrace and examine stance, and discover all sources of information.

3.2.2 Qualitative Research

An effective definition of research is a systematic way of asking questions (Drew, Hardman and Hart, 1996). As such, it is a systematic process of collecting, analysing and interpreting data in order to increase understanding of the phenomenon of interest or concern (Leedy and Ormrod, 2005:2). A wide range of rationale is that research is an orderly and structured effort to examine a specific problem that needs a solution (Sekaran, 2003:4). A review of literature by McDaniel and Gates (2001) indicates that business research is a systematic and objective process of gathering, recording and analysing data for decision making. A consensus has emerged in relation to research explanation, that it is a way of finding answers to questions about the social world or data gathering to enable the researcher to answer questions about the social world (Neuman, 2006). Typically, people undertake research to find out things in an orderly way to increase their understanding (Saunders, Lewis and Thornhill, 2003:3). The rationale for undertaking research is because it is a scientific investigation to establish facts and provide new conclusions (Brynard and Hanekom, 1997). The most common reason to use qualitative research is to seek better understanding of difficult situations and is sometimes (although not always) exploratory in nature. Naturally, qualitative research may use observations to build theory from the ground to the top. Therefore, it is holistic and evolving with specific focus, design and measurement tools, and interpretations developing and possibly changing along the way (Leedy and Ormrod, 2015:98-99).

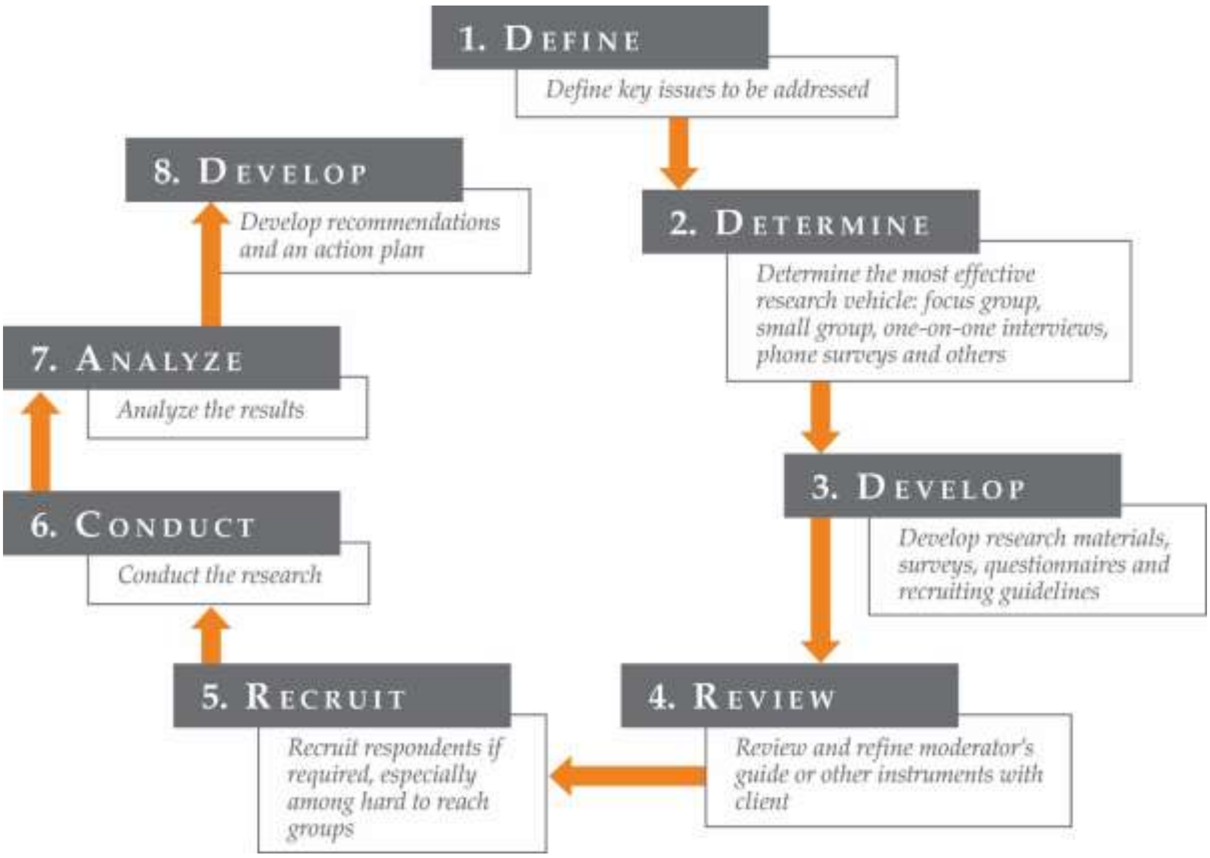

Figure 3.1: Qualitative research process (Zacharias Group, ND).

3.3 RESEARCH METHODOLOGY

The essence of research generally requires a particular methodology before getting data or analysing the data. Therefore, research methodology is generally expressed as the ways in which data are collected (McNabb, 2010:41). To find a sense of reason instead of drowning in depth of confusion research methodology is the "how" of gathering and handling data within a framework of the research method (Brynard and Hanekom, 2006:35). It has been thoroughly explored and is defendable by evidence that the primary aim of research methodology is to focus on the research process and the kind of tools and procedures that are to be used. Of course, in order for the research process to be considered as being objective, the researcher should focus on individual steps that are developed to conduct the study (Babbie and Mouton, 2011:74-75). Overwhelming, these steps are guided by research problems and the type of answers that are required to solve the problems. In context, the studies are conducted to develop a casual explanation of a phenomenon (Clarke, 2011:15).

3.3.1 Population

In view of literature, population is any complete group of entities that share some common characteristics. Essentially, it provides a group of elements from which a researcher samples and likely to generalise (Clarke, 2011:102). It is extremely important to note that the population of the sampling method selected for this study was non-probability sampling which had elements identified as known and not zero probability. In particular, this means that the sample was drawn in a way that does not give every participant of the inhabitants a known chance of being nominated (Clarke, 2011:102; Fox and Bayat, 2011:54).

3.3.2 Sampling strategy

The method by which the researcher reduces the total population for a research project to a number that is practically realistic and theoretically suitable is called sampling. In depth, the identification of the research sample must depend on the research questions that the researcher wants to be answered. Therefore, the researcher must ensure that the sample include people that will give the kind of information he/she is seeking (Leedy and Ormrod, 2015:279-284). The sampling strategy, that is design and size, depends on the research paradigm (Leedy and

Ormrod, 2005). Sampling in qualitative studies is based on qualities rather than quantities, with the researcher searching for participants who might offer rich, thick descriptions of the phenomena under study (Holloway and Wheeler, 1996). Perhaps not surprisingly qualitative researchers believe that everyone is different (Nicholls, 2009:590).

The selection criteria for inclusion in this research study was IT professionals and management who articulate experience, as it relates to the Green IT phenomena to be investigated from eight South African companies. The participants were selected purposefully because of their distinctive expertise, knowledge, experience and ability in IT and management field.

The researcher utilised a non-probability sampling method, which is also referred to as theoretical or judgemental sampling because the sample was purposive. This method of selecting research participants was done according to the needs of the study, and the researcher selected participants that were suitable and likely to give rich information. In theory, through this method, participants are likely to generate useful data for the research project (Glaser and Strauss, 1967). Similarly, through the judgemental sampling method, the researcher actively selects the most productive sample (Marshall, 1996:523). In reality, participants are likely to provide meaningful insight and understanding into the phenomenon of Green IT implementation by utilising judgemental sampling. Therefore, it was imperative for the researcher to utilise this method in order to seek appropriate sample that would adequately answer the research questions. However, the limitations of the chosen method are mostly criticised because the sample is small and may not represent the broader population, and the finding may lack rigor. Then again, it is difficult to tell how far the findings are biased by researcher's opinion. Despite the stated criticism, the researcher designated purpose sampling in this case because it would increase comprehensive understanding by selecting participants with wealth of information and experience in Green IT.

3.3.3 Non probability sampling

From the sampling point of view, the researcher has no way of predicting or ensuring that each element of the population will be represented in the sample hence the selection of non-probability sampling. In line with this selection, it is envisaged that some of the population have slight or no chance of being sampled (Leedy and Ormrod, 2015:182). In view of this concern, the researcher believes that this method of sampling will provide a range of alternative techniques to select samples based on the researcher's subjective judgement. In order to enable the researcher to answer the research questions and to meet his/her research objectives the researcher needs to undertake an in-depth study that will focus on a small group. It is envisaged that this sample will provide the researcher with information rich case study in which the researcher can explore the research questions (Saunders, Lewis and Thornhill, 2007:226).

Deliberate sampling is also known as purposive or non-probability sampling. This sampling method is purposive or deliberate selection of particular unit of the universe for constituting a sample which represents the universe. When population elements are selected for inclusion in the sample based on the ease of access, it can be called convenience sampling. The focus of quality research is mainly on depth and the emphasis is rarely a sheer number of participants. Therefore, purposive sampling was chosen in relation to the research design and methodology because the researcher believed that this technique would yield a representative sample.

In purposive sampling, the researcher uses his/her discretion to choose the population members that are likely to give the anticipated or correct information. Therefore, this enables the researcher to select cases that will best enable him/her to answer the research questions and meeting the research objectives (Saunders, Lewis and Thornhill, 2007:230). In context, purposive sampling is an acceptable kind of sampling for special situations that use judgement of experts in selecting cases or it selects cases with a specific purpose in mind. The researcher utilises this technique to select distinctive cases that are informative (Neuman, 1997:206).

Purposive sampling involves the selection of subjects that are fully armed with information that will be appropriate for the researcher's focus. This means the selection of the sample reflects the drive or goal of the investigation. Therefore, purposive sampling may be very appropriate for certain research problems. However, researchers should provide a rational explanation on why they selected the particular sample of participants. Qualitative researchers are operating under the assumption that reality is not easily divided into discrete, measurable variables. As a result, they have a tendency of selecting few participants who might shed light on the phenomenon under investigation. Purposive sampling is employed when the desired population for the study is uncommon or very difficult to locate and employ. It is important for the researcher to target a particular group of people whose background and expertise relate to the objective of the study (Leedy and Ormrod, 2015:99-183).

The primary aim of purposive sampling is to construct a sample that is meaningful theoretically, build in certain characteristics or conditions and assist in developing and testing findings and explanations (Hox and Boeije, 2005:595).

3.3.4 Conceptual saturation

There is strong evidence that suggests that researchers should carry on in developing a sample until they have reached saturation in their data (when researchers are not producing any significant new insights in relation to their core questions), no new information is coming forward; no new categories are coming to light in the selected nonprobability sampling. This means that the researcher should continue to collect data until the researcher is no longer gaining new insight about the phenomenon of interest (Leedy and Ormrod, 2015:319).

3.3.5 Research design

It important to note that research design can be something that is rigid or flexible. In essence, it is the general plan of how the researcher will proceed to solicit the answer to the research questions (Saunders, Lewis and Thornhill, 2007:131). The main function of a research design is to make sure that the evidence that is collected allows the researcher to answer the research question as clearly as possible. In order to obtain relevant evidence, it is important to specify the type of evidence that is required to answer the research question to test theory, evaluate the programme or accurately describe some phenomenon. In view of this concern, the designing of research question by the researcher should solicit the type of evidence needed to answer the question in a more convincing way (Bless, Smith and Kagee, 2006). More importantly, the research design should be supported by a thorough understanding of epistemological conventions and explicit articulation of what the study intends to achieve (Sinkovics and Alfodi, 2012:833).

It is acknowledged that research design is the general plan on how the researcher will answer the research questions. However, these research questions should comprise clear objectives that are derived from the research questions, specifying the sources from which the researcher expects to collect data and bearing in mind the restrictions that will be inevitable and discussing ethical issues (Saunders, Lewis and Thornhill, 2007:131). In broader context, research design is regarded as the plan or blue print of how the researcher intends to conduct research with the framework of the research process (Fox and Bayatt, 2010:145). However, a contradictory notion exists that research design is not only a work plan, but it is a work plan that details what should be done to complete the research project (Schurink, 2003:3). The purpose of the research design is to ensure that the evidence that is attained allows the researcher to answer the original questions as ambiguously as possible. It deals with logical problems rather than logistical problem and it actually refers to the structure of an enquiry. In a nutshell, the research design should provide the answer to the question of what the researcher needs and the means which should be used to obtain such information (Babbie and Mouton, 2007).In effect, qualitative research design data collection typically involves gathering a huge amount of data on a rather small, purposive sampling, using techniques such as in-depth interviews, participant's observation or focus group (Hox and Boeije, 2005:593).

3.4 MOTIVATION OF QUALITATIVE APPROACH

The research study design is exploratory in nature, hence the researcher utilised qualitative research. The rationale for utilising qualitative research is because it is grounded in a philosophical position and is concerned with how Green IT phenomena is interpreted or understood. Research studies indicate that qualitative research method provides rich, contextual data and intends to produce rounded understanding. The primary impetus of qualitative research methods is to answer about what, how and why of a phenomenon in order to gain an understanding. It is for this reason that qualitative research method searches for understanding a given problem or subject from the perspective of the population (Schurink, 2003:3). Inevitably, quality research sheds light and brings forth understanding of complex issues and is inclined to explore a holistic picture because the researcher is interested to understand the meaning of the phenomena. Qualitative approaches are characteristically flexible since they permit greater freedom and adaption of the collaboration between the researcher and study participants (McFadzean, 2007:2).

There is strong evidence that suggests that qualitative research focuses on phenomena that are happening or have previously happened in natural setting, that is, the real world. It therefore involves capturing and studying the complexity of those phenomena. The truth is that qualitative study can help define what is significant and what needs to be studied when little information exists on a subject, when variables are unknown and when applicable theory is missing (Leedy and Ormrod, 2015:269).

Qualitative research is primarily concerned with the quality of information, qualitative approaches endeavour to gain an understanding of the underlying reasons and incentives for actions and establish how people interpret their experiences and the world around them. In other words, it provides insights into the setting of a problem, generating ideas and/or hypotheses. Essentially, it follows a process of inductive reasoning (where theory is developed). In most instances, it often begins with a small sample size (sometimes an individual participant, a solitary text documents or a small group) and follows a rigorously applied but loosely defined pathway and there is no hypothesis to be tested, only a research question to explore (Nicholls, 2009:590).

The most important thing is that in qualitative research the connection between the researcher and participants is a natural one that develops with the study (Holloway and Wheeler, 1996). Similarly, qualitative research permits the study to progress naturally rather than imposing an inflexible methodological approach on it from the onset, analyse the data that is being collected. In context, qualitative researchers look to hand over control of the study (to a greater or lesser extent) to their participants thus permitting them to define matters to them and what is excessive. In principle, qualitative researchers are equally meticulous in showing that their findings are trustworthy and they approach the question of bias differently. In reality, quality research does not set out to represent variables possessed by background population. Instead qualitative research attempts to build theory that is generalizable to others. In depth, high quality research builds robust theory through a transparent, rigorously applied process analysis and it carries qualitative weight to influence what is known and understood about a phenomenon.

A clear picture that provides the difference between quantitative and qualitative research is indicated in Table 3.1.

Table 3.1 Overview of the difference between quantitative and qualitative research (Nicholls, 2009:591)

Description	Quantitative	Qualitative
Purpose	Test theories Establish facts Show casual relationships Predict outcomes Generalise results to specific populations	Develop concepts Explore meaning Describe multiple realities Critique multiple perspectives Produce generalisable theory
Design	Predetermined Structured Unchanging Prescriptive Reproducible	Evolve through the study Continually under review Rigorous application Unreproducible Unstructured
Data	Numerical Quantifiable Statistical Measurable Pre-defined variables	Deals with qualities Extensive Wide ranging Texts emerge throughout Limited use of numerical information
Sampling	Subjects Large numbers Structured selection Represent population Control groups and placebo	Participants Small numbers Purposive and theoretical sampling No effort to represent No control groups / placebo
Participant relationships	Detached Distant Objective , try to be free from bias No interaction or influence Research done on subjects	Participatory Trusting and close Subjective , biases incorporated Acknowledge influences Research done with people
Methods	Experiments Quasi-experiments Surveys Questionnaires Incidence studies	Interviews Observation Focus groups Document analysis Theoretical

Instruments and tools	Scales Tests Inventories Hardware , goniometers , dynamometers	Researcher Recording equipment Schedules
Data analysis	Attempt to falsify experimental hypothesis At the end of data collection Deductive Statistical manipulation Computer packages	Theory builds throughout On-going Occurs throughout Repeated re-analysis Inductive
Outcome	Answer specific hypothesis Statistical analysis Compare findings to other studies Often results in guidelines to follow Test establish theory	Critique problems Narrative / linguistic analysis Words not numbers Thick description Development of new theory
Problems	Controlling variables Relevant to reality Reductionist Western	Non-standard procedures Large volume of words Intensity Doesn't give you a simple answer Time consuming

Research studies indicate that qualitative researchers are examining how people learn about and make sense of themselves and others as well as how they structure and give meaning to their daily lives. Subsequently, the method of data collection that is used should be flexible and sensitive to the social context. Qualitative researchers create new concepts and theory by blending together empirical and abstract concepts, while quantitative researchers manipulate numbers in order to test a hypothesis with variable constructs (Hox and Boeije, 2005:595).

Qualitative research studies have potential advantages, strength and limitations (Nicholls, 2009). Typically they serve one or more of the following purposes:

- Exploration: They can help you gain initial sight into what has been a little studied subject or phenomenon
- Multifaceted description: They can reveal the complex, possibility multi-layered nature of certain situations, settings, processes, relationships, systems or people.

- Verification: They allow you to test the validity of definite assumptions, claims, theories, or generalisations within real world contexts.
- Theory development: They can enable you to develop new concepts or theoretical viewpoints related to a phenomenon.
- Problem identification: They can help you uncover key problems, obstacles or conundrums that exist within the phenomenon
- Evaluation: They provide a means through which you can judge the effectiveness of particular policies, practices or innovations.

3.4.1 Strength of qualitative research

The following are the strength of qualitative research:

- It is an ideal tool for exploration
- It helps in forming the foundation for quantitative research
- It gives deeper and more penetrative feedback
- It generally provides human perspective in a better fashion
- It attempt to avoid pre-judgement

3.4.2 Limitations of Qualitative research

The following are regarded as limitations of qualitative research:

- The number of participants is less
- It is difficult to generalise the results
- Data interpretation is not easy
- It generally does not minute difference in opinions

3.5 CASE STUDIES

A case study is regarded as a strategy for doing research which involves empirical investigation of a particular contemporary phenomenon with its real life context using multiple sources. It is important to note that there are times when researchers focus on a single case because of its distinctive or exceptional qualities that can promote understanding or inform practice for similar situations. On the other hand, there are times when researchers can study two or more cases, often cases that are similar or different in certain key ways to make comparisons, build theory, or propose generalisations and such approach is called multiple or collective case study. Typically, the researcher collects extensive data on the individual(s), programme(s) or event(s) on which the investigation is focused. In view of data collection, it often includes observation, interviews, and documents, past records and audio-visual materials (Leedy and Ormrod, 2015:271-272).

It is acknowledged that researchers gather data for a period of time to produce the best theory. In view of literature, the cases can be individuals, groups, movements, events, or geographic units. The data collected is often more detailed, varied and extensive. To be explicit, in case studies the researcher intensively investigates one or two cases or compares limited set of cases, focusing on several factors (Neuman, 1997:30). On the contrary, multiple case studies may be preferred to a single case study (Yin, 2003). The rationale for using multiple cases focuses upon the need to establish whether the findings of the first occur in other cases and as a consequence the need to generalise the findings (Saunders, Lewis and Thornhill, 2007:139-140). Research approach for this study was in a form of a multiple case study.

3.6 DATA COLLECTION

The phenomenon of data collection is described as how the researcher obtains empirical data that will be used to answer research questions. In theory, the method of data can be tests, questionnaires, interviews, focus groups, observations and existing secondary data (Christensen et al., 2011:2015). The data collection in this study was through interviews.

3.6.1 Interview Development construction

The interview development matrix was used to develop research interview questions. In the ultimate, this assisted in reviewing each research problem into sub-problems; formulating a research interview question that is aligned with each sub-problem; deconstructing each research interview question into a thematically interrelated interview questions; determining the appropriate scale for each interview question; determining the data type of each set of response options; determining the suitable data measures for each research interview question and the appropriate statistical test for specific data types (Klopper and Lubbe, 2011).

3.6.2 Primary data

Primary data refers to data that are collected for specific research problem at utilising procedures that fit best to the research problem (Hox and Boeije, 2005:593). More importantly, this data directly emerge or emanate from an observable phenomenon (Leedy and Ormrod, 2015:296). Primary data are the original information that is gathered by the researcher precisely for the research study at hand and the data are attained through interviews and surveys (Leedy and Ormrod, 2005).

3.6.3 Data collection instruments

Data collection was conducted through interviews. The researcher followed an inflexible procedure intended to seek answers in order to set preconceived questions through interviews. This method of collecting data was carried out in a semi structured way where output depended upon the ability of the research interviewer to a large extent. In theory, there are different methods of collecting data and it is depended on the purpose and intention of the study (Struwig and Stead, 2010:98).

3.6.3.1 Personal interview

A prevalent method of data collection is the qualitative interview in which interviewees are given a platform to discuss their experiences and so forth in personal interview (Hox and Boeije, 2005:595). This type of interview has a distinct advantage of allowing a researcher to create a relationship with potential participants and therefore gain their collaboration (Leedy and Ormrod, 2015:160). For the purpose of this study, the interviews were recorded on a digital recorder, transcribed and analysed by the researcher and his assistant. The participants were informed beforehand about the recording and their consent was obtained before the interviews commenced.

3.6.3.2 Structured interview

This type of interview follows a set of specific questions which are worked systematically. It is used when the researcher wishes to acquire information where responses are directly comparable (MacDonald and Headlam, 2011:41).

3.6.3.3 Exploratory interview

These are the most frequently used type of interview as they are relevant to most types of research project. These types of interviews are usually conducted with representatives that have a strategic role in the research (MacDonald and Headlam 2011:41).

3.6.3.4 Unstructured interview

The unstructured interview differs from structured interviews in the sense that they are not bound to a previously compiled list of questions. The researcher is allowed some opportunity to depart from his/her role as a detached interviewer and interacts with the individual with whom the interview is conducted with unstructured interviews. Therefore, the researcher does not stick to the suggested questions but is allowed some flexibility in asking questions that were not included in the attached list of questions for participants (Welman and Kruger, 2003:188). This simply means that the interviewer suggests the general themes of discussion and poses further questions as these come up in the spontaneous development of the interaction between the interviewer and research participants. The research questions utilised in this research study were not fixed and were allowed to evolve during the interview process.

3.6.3.5 Semi structured interview

Semi structured interviews do not assume that the researcher anticipates enough answers to be able to pre-format the questions, and do not allow the study to proceed aimlessly and meandering through whatever topic the interviewee cares to bring up (Nicholls, 2009:640). Therefore, planning for data collection is critical for a research project. This stage requires the researcher to answer questions relating to the following: identifying which data to collect, where the data are located, how the data will be obtained and how they will be interpreted (Leedy and Ormrod, 2013:80). The researcher should decide on a broad way of enquiry, or may formulate a broadly based research question, and will look for patterns and recurrences in the data, interpret patterns, define interrelationship among categories identified in the data and attach meaning (Saunders et al., 2003:402).

For the purpose of this study, a semi-structured interview was utilised using open ended questions, thereby allowing participants the freedom to control the pacing and subject matter of the interview. The rationale behind the usage of semi-structured interviews is that it seeks to cover both factual and meaningful information, and participants had the opportunity to respond more elaborately and in greater detail. Furthermore, participants had the opportunity to respond in their own words, rather than compelling them from fixed responses. These semi-structured interviews were conducted with IT personnel and management from the sampled organisations.

All interviews were recorded with the permission of the respondents being interviewed. After the interviews the recording was transcribed into computer files. The researcher recorded the information and made use of hand written notes. Care was taken by the researcher to assure the respondents that they will not be identifiable, including their workplace in any subsequent report. Transcript of the interview was sent to the participant to get the participant’s written acknowledgement for its accuracy or corrected copy. The participants were informed that once the final research report was written, the tapes from interviews would be destroyed.

3.7 DATA ANALYSIS

The initial stage in the analysis of data is the critical examination of the data itself (McNabb, 2010:243). In theory, data analysis is an organised and fundamentally taxonomic process of arranging and classifying the data that have been collected. In broader context, it is an interactive and reflective process that begins as data are being collected, rather than after data collection has ceased (Stake, 1995). In this multiple case study, data analysis includes the data collected through interviews. In this study, the responses provided were analysed against the questions asked during the course of interviews and the literature review discussed in chapter 2.

3.7.1 Process followed in preparing and analysing the data

When data have been collected, it is the task of the researcher to analyse the collected data. This analysis of data requires a number of closely related operations such as establishment of categories, application of these categories to raw data through coding, drawing statistical inferences and correspondence analysis. In relation to coding, the operation is usually conducted through categories of data that are transformed into symbols and may be tabulated and counted.

3.7.2 Tests used in the analysis

Soft packages such as SPSS are capable of producing three dimensional scatter plots (Greenacre, 2009:3107). The following tests were used in the analysis of the results of this study:

- Descriptive statistics including means and standard deviations, where applicable. Frequencies were represented in tables or graphs.
- Chi-square goodness-of-fit-test: A univariate test, used on a categorical variable to test whether any of the response options were selected significantly more/less often than the others. Under the null hypothesis, it is assumed that all responses are equally selected.
- Binomial test: Tests whether a significant proportion of respondents select one of a possible two responses. This can be extended when data with more than 2 response options is split into two distinct groups.
- Correspondence analysis: is a descriptive/exploratory technique to analyse simple two way and multi way containing some measure of correspondence between rows and columns. It’s a graphical technique used to explore relationship between the variables in a two way cross tabulations.

Several studies indicate that qualitative data analysis is in the form of words, which are relatively imprecise, diffuse and context base but quantitative researchers use language of statistical relationships in analysis. In line with this view, qualitative research is considered to be less standardised with wide variety in approaches that are matched by many approaches of data analysis. Therefore, it is incumbent upon qualitative researchers to choose from a specialised and standard set of data analysis technique (Kreuger and Neuman, 2006:434-435). This analysis should be systematic, sequential, verifiable and continuous because they require time since they are jeopardised by delay. In broad context, this is a process of comparison, improved by feedback that seeks to enlighten and entertain alternative explanations (Morgan and Krueger, 1998:17).

In view of literature, qualitative researchers make a considerable use of inductive reasoning. Naturally, they make many specific observations and then draw inferences about larger and more general phenomenon. They scrutinise the body of data in search of patterns. After they have identified themes in their data using an inductive process they typically move into a more deductive mode to verify and modify it with additional data (Leedy and Ormrod, 2015:100).

Empirical evidence indicates that quality research has various procedures for analysing data. The analysing process starts once the data collection has been completed, although the two processes may run concurrently (Fox and Bayat, 2011:105). Intrinsically, large amount of data was gathered and this presented challenges during data analysis of this study as the researcher tried to reduce the volume of information into manageable portions by reducing the collected data and identifying patterns and themes in the data. The data must speak for itself because the researcher is the mouth piece (Mouton, 1996:161). Fundamentally, the researcher must be a servant of the scientific method. The primary reason for this is to ensure that the method looks at evidence squarely and without prejudice, it should report candidly and precisely what impersonal data affirm (Leedy and Ormrod, 2015:352).

3.7.3 Coding

The transcriber and the researcher were engaged in verbatim transcription of all the interviews. As such, they engaged in generalising transcription to assure the anonymity of participants as well as preparing the transcripts of the research to code for statistical analysis (Refer to Appendix 5).

3.7.3.1 Open coding

In open coding, the data is usually divided into segments and then examined for commonalities that reflect the general categories or themes. Then again, the data are further examined for properties or specific attributes or subcategories that characterise each category once meaningful categories are identified (Leedy and Ormrod, 2015:315).

3.7.3.2 Axial coding

In axial coding process one or few categories are likely to emerge as being a central phenomenon under examination. The categories are chosen as core categories and are identified as possibly reflecting the core context in which they are embedded, the conditions that give rise to such core category, strategies that people should use to carry out the category, conditions that influence the process of the strategies and the consequences of such strategies. The axial coding process is repeated using code as core categories and is helpful if it is appropriate (Leedy and Ormrod, 2015:316).

3.7.3.3 Selective coding and theory development

In this category a single category is selected as the core concept in phenomenon. As a result, theory is developed based on this concept and its interrelationship with other categories. The results of the selective coding are most likely to be general story line that describes "what happened" in the phenomenon under investigation (Leedy and Ormrod, 2015:316).

In this research study, the qualitative data were coded using an iterative process of reviewing the transcribed data. In the ultimate end, attach the codes to the qualitative interviews. The coding book is included as a reference.

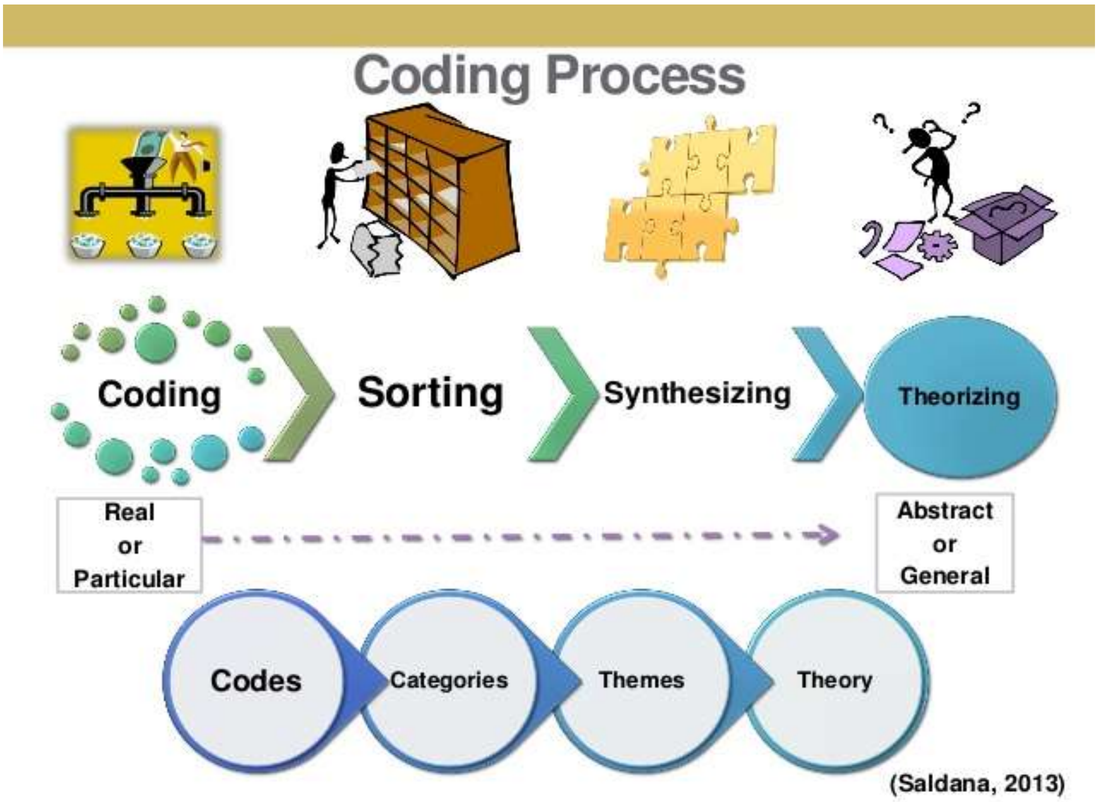

Figure 3.2 Coding Process

3.7.4 Narrative analysis

Narrative refers to an account of experience that is told in sequence, indicating a flow of related events that are significant for the narrator and which conveys a meaning to the researcher. In the same way, narrative analysis is the collection and analysis of qualitative data that preserves the integrity and narrative value of data collected to avoid the possibility of fragmentation. It is for this reason that the researchers should retain the integrity of data that they collect and start analysis from the basis of the verbatim transcripts or complete set of notes that are being produced (Saunders, Lewis and Thornhill, 2007:504). In this study, narrative analysis was performed on the qualitative interviews on an iterative basis and extracting the themes from each interview and comparing them for investigation purposes. Intrinsically, data that are used in social research requires interpretation which is termed narratives (Riessman, 2003:2).

3.8 VALIDITY OF THE RESEARCH

Research studies indicate that some of the researchers have suggested that the notion validation, such as reliability and validity should not be considered a criterion for evaluating qualitative research. In contrast, other researchers suggest that although validation is important for qualitative research, it should be called something else other than reliability and validity to distinguish it from what is done in quantitative research. Regardless of the different views of validation in qualitative research, a consensus emerged among authors that validation is essential in qualitative research to reduce misunderstanding of qualitative research and to develop a common scientific body of knowledge (Venkatesh, Brown and Bala, 2013:34).

The word validity is an overused term and is often confused with related ideas. It is used to mean true or correct. In essence, validity is part of a dynamic process that grows by accumulating evidence over time, and without it, all measurement becomes meaningless (Neuman, 1997:141). It is regarded as one of the most important criteria for the suitability of any data set of measurement (Saunders, Lewis and Thornhill, 2007:263). The quality of research is evaluated by the validity and reliability of the results (Leedy and Ormrod, 2015:103).

In light of this research study, qualitative validity was determined through the use of strategies to check accuracy of the findings through triangulation from different data sources, in order to build a coherent justification for the themes. Thus, validity was captured through trustworthiness, authenticity and credibility. In context, validity is the reason people have for believing truth claims (Newton and Burgess, 2008). In simple terms, it basically means accuracy about the research findings (Adams and Lawrence, 2015:69). A reliable study offers little value if the results of the study are not valid. This means, the results of the study should be a true reflection of reality (Collis and Hussey, 2003:186).

It must be noted that validity is not a single dimensional effort but rather requires integrated effort on several fronts to conclusion that may be defended as valid (Roe and Just, 2009:1266). Validity is crucial in management research, measuring unobserved measures which are very common and that they may be contaminated by measurement error. The measurement error may lead to biased parameter estimates whereby a true substantive relationship may be rejected or a relationship may be proved to be present where actually none exist. Invariably, this measurement error threatens the validity of research findings and undermines much of its contribution (Brahma, 2009). There is a possibility that the research design can be very reliable with the study being able to produce same results consistently while the results are flawed and consistently invalid. Therefore, study should answer the research questions correctly and accurately (Stemler, 2001).

There is gradual concern about the validity of the research that is currently being used. Hence the researchers must pay attention to the value that is added to the body of accumulated knowledge (Remenyi, 1996:25). In most instances, the qualitative researchers use variety of strategies to enhance validity and reliability, and this results in credibility of the data they collect (Leedy and Ormrod, 2015:278).

Internal validity of research means the degree to which the design and the data it produces permit the researcher to draw truthful conclusions about cause and effect and other associations within the data (Leedy and Ormrod, 2015:103). It should be noted that there should be no errors internal to the design of the research project (Neuman, 1997:145).

External validity of research is the extent to which its results apply to situations beyond the study itself or the extent to which the conclusions drawn can be generalised to other contexts (Leedy and Ormrod, 2015:105). This external validity has the ability to generalise findings from a specific setting and small group to a broad range of setting and people (Neuman, 1997:145).

Measurement validity is the degree of fit between a construct and indicators of it (Neuman, 1997:141).

It has been thoroughly explored and defendable by evidence that quality researchers don't necessarily measure things, at least not in numerical sense of the word. However, they should be concerned about both the validity and the reliability of the data they collect. In particular the data they collect must be both reasonably accurate with regard to the characteristics and dynamics of the entities or situation being studied and consistent in the patterns and dynamics they reflect (Leedy and Ormrod, 2015:278). The quality researchers don't necessarily use the term validity in describing their research. Instead they use words such as quality, credibility, trustworthiness, confirmability and interpretative rigor (Creswell, 2013). In principle, validity is primarily concerned about whether the findings are really about what they appear to be about (Saunders, Lewis and Thornhill, 2007:150).

3.9 RIGOR

The researchers should be rigorous, be precise and utilise thorough methods to collect, record and analyse data. In other words, they should strive for rigorous subjectivity which means that they should take steps to ensure that their analysis and interpretations are credible and defensible in the eyes of colleagues and other well informed individuals. This means that they should take steps to remain as objective as possible throughout the project (Leedy and Ormrod, 2015:288-319). Therefore, qualitative rigor assists in the establishment of trustworthiness of the research (Krefting, 1991:214). This research study endeavoured to provide significant rigor into the research by taking into consideration the concepts revealed in the literature of the topic at hand.

3.10 RELIABILITY OF THE RESEARCH

The crux of reliability is the extent to which data collection techniques or analysis procedures yield consistent findings (Easterby-Smith et al., 2002:53). This reliability can be assessed by measures that yield the same results on other occasions, similar observations in the sense made from raw data and transparency on the sense made from raw data. In context, reliability means consistency of the research findings (Saunders, Lewis and Thornhill, 2007). Of course, the results cannot be valid unless they are reliable (Adams and Lawrence, 2015:69). The underpinning of qualitative research methods validity should take priority over reliability because arguments concerning the content are considered more important than methodological issues (Kohlbacher, 2005). In contrast, the phenomenological paradigm and qualitative research lend themselves to results of high validity but tend to produce less reliable results (Collins and Hussey, 2003:55).

Research studies indicate that it was Churchill (1979) who first proposed a systematic procedure to develop a valid and reliable instrument in management literature. Subsequent to that, the realisation of the need to develop a sound management construct in advancing research by bringing rigor to the process of scientific enquiry has propelled scholars to highlight this area in research (Brahma, 2009). This study followed a qualitative methodology and emphasis was on the validity of the results. As such, reliability is necessary for validity and is easier to achieve than validity. Although reliability is necessary in order to have a valid measure of concept, it does not guarantee that a measure will be valid. It means that the method of conducting a study or the results from it can be reproduced or replicated by other researchers (Neuman, 1997:145). Therefore, reliability requires the study process to report in detail. For the purpose of maintaining reliability in this study, qualitative interviews were recorded by means of audio and the recording was transcribed. The transcriptions were compared to the audio recording to ensure accurate interview on the Micro Soft Word document.

3.11 ELIMINATION OF BIAS IN RESEARCH

It is acknowledged by previous studies that in quality research personal bias are unavoidable feature of humanity, and one that is important if the researcher has to explore feelings, meaning and personal context of participants' life experiences and reflecting their meaning to research (Nicholls, 2009:590). The allure of researcher's affiliation may result in response being biased. On the other hand, reputable organisations are likely to attract positive respondents who answer questions with seriousness and authenticity. In contrast, suspicious or unknown organisations will react negatively to the interview (Mouton and Marais, 1990:81).

In research people are telling the researcher what they believe to be true or perhaps what they want to hear. Therefore, the extent to which people describe their thoughts, beliefs and experience inaccurately means response bias is highly at work. In light of these views, the potential effects of the researcher's expectations, values and general system can predispose the researcher to study certain variables and excluding other variables, as well to drawing conclusions on other variables and excluding others. Therefore, this should not be overlooked. However, it should be remembered that not human being can be completely objective (Leedy and Ormrod, 2015:188).

It is imperative for qualitative researchers to describe personal beliefs and attitudes that may potentially be slanting observations and interpretations. This means, they should actively try to recognise personal, social, political, or philosophical biases that are likely to affect their capability to gather and interpret data. This self-reflection is known as reflexibility, and takes whatever steps they can to reduce such influences. Inadvertently, any qualitative researcher must continually acknowledge, both to self and to others that personal attitudes and opinions are inevitably creeping into and biasing observations and interpretations. As a result, they should not claim that they have approached a project with complete objectivity (Leedy and Ormrod, 2015:106-309). In this study, the researcher submitted a transcript of the participants to get written acknowledgement of the interview accuracy. The researcher requested each participant to acknowledge the transcript for validation purposes and to determine if the participants agreed with his conclusions and if the conclusion was making sense in accordance with their experience.

3.12 ETHICAL CONSIDERATION

In view of research study, the researcher must anticipate any ethical issues that may arise during the qualitative research process, which involves collecting data from people. In essence, the researcher should protect the research participants by developing trust in them, promoting the integrity of the research, guarding against misconduct, and any impropriety that might reflect on their organisations or institutions, and cope with challenging problems. This means, the researcher has an obligation to respect the rights, needs, values, and desires of the participants. Interestingly, phenomenological research is known to solicit sensitive and deep answers from questions extracting meaning from statement and opinions. As a result, the reputation and position of the participants are visible in the findings of the study, and could be shared with other people and organisations (Creswell, 2009).

In this study, the researcher ensured that no physical, psychological and emotional harm occurred to voluntary participants, and endeavoured to eliminate coercion or deception. The participants were invited to take part in this study with clear conscience and understanding, that they were not under obligation to be involved, and there were no undesirable consequences for them, if they were unable to assist or participate in the study. Any involvement was voluntary; and there was no penalty for not participating. Specific information from the research was to be given to the employer.

Ethical issues involve the researcher avoiding the deception of participants and maintaining confidentiality. As a result, an ethical clearance was obtained from the North West University Research Ethics Committee with a code of ethics that provides guidelines. The researcher was granted permission by the sampled companies under study. The participation in the study was not made compulsory and participants were allowed free will to choose, and anonymity in the research tool (interview) was maintained. The research objectives were clearly delineated in writing and articulated to the participants. Furthermore, the participants were advised in writing of the voluntary nature of their participation and that they could withdraw from the study anytime without penalty. They were also advised that any time during the interview process they can decline to answer any question. Moreover, a written concern form was obtained from each participant. The participants were also informed in writing about the data collection methods and activities and provision was made for monitoring of the data collected to ensure safety of participants. Again, the participants were informed that a written transcription and interpretation of data would be made available to them. Also, they were informed about their rights, interests and wishes that would be considered first when choices are made regarding reporting the data. They were also informed that the tapes would be erased after the data had been transcribed. The risk to participants in this study was minimal.

3.13 CHAPTER SUMMARY AND CONCLUSION

In this Chapter the research design and the research methodology, including the population and sample size have been discussed. The study provided detailed account of both data collection techniques and data analysis that was utilised and presented. Furthermore, matters relating to validity and reliability of the study have been detailed and ethical matters on the research were clarified.

In the previous chapter, the research was stated in terms of questions that remained unanswered from the literature review. This chapter defines the research methodology used in this study to give answers to raised questions. The interview development matrix was developed in this study to provide answers to the research questions developed in Chapter 2.

The research questions ask what methods of technology can be used to reduce pollution and contribute to the optimal use of renewable energy, what approach can be used in the design, production, operation and disposal of IT product in a manner that is not harmful to the environment, what strategies can be used to help IT contribute to environmental solutions, what sources can be used to determine the impact of adoption of strategic Green IT towards creating a sustainable environment?

The aim of this study was to develop a framework for Green information technology implementation in South African organisations. To develop the Green IT framework it is necessary to collect information from targeted population using the correct methodology and analyse the responses. This chapter begins with an introduction on the research methodology that is applied in this research. This is followed by philosophy paradigm, research methodology, motivation for qualitative research, case studies, data collection, data analysis, validity, rigor, reliability of research, elimination of bias, ethical consideration and conclusion.

Overall, this chapter defines the research methodology used in this study, the data collection method chosen, types of questions that were asked and development of the interview questions, the population and sample size determination, data handling and concludes with the discussion of the researcher's compliance with research ethics.

The next chapter provides a presentation of findings, a detailed discussion and interpretational and statistical analysis of the data collected from the research methodology described in Chapter 3.

CHAPTER 4: DISCUSSION OF THE RESULTS

4.1 INTRODUCTION

This chapter discusses the research findings and provides analysis and interpretation of data. The results presented in this chapter are based only on the participants who were eligible for selection mainly as IT personnel and management from different companies. The objective of this chapter is to describe how the case study evidence was analysed including the development of the thesis. This chapter discusses how correspondence analysis was used to authenticate the findings of the Chi-square.

The data collection was conducted through semi- structured interviews with IT personnel and management from eight different South African companies to determine how they implement Green IT within their companies with the aim of developing a framework in order to overcome the negative IT challenges. The rationale for utilising the semi-structured interview was to cover both factual and meaningful answers for this study. This method allowed the participants the freedom to control the pacing of the interview, and provided the participants with an opportunity to respond more elaborately and in greater detail. The interview development matrix was used to develop research questions to determine the appropriate scale for interview questions, determining the data type of each set of response options and determining suitable data measures for each research question and appropriate statistical test for specific data (Refer to Appendix 4). The transcriber and the researcher engaged in verbatim transcription of all the interviews. As such, they engaged in generalising transcription to assure the anonymity of participants as well as preparing the transcripts of the research to code for statistical analysis (Refer to Appendix 5).

The purpose of this study was to make contribution to the development of a framework for South African organisations. As a result, the focus has been to explore technology optimisation, data centre management, e-waste management, legislation and regulations and how Green IT framework can enhance business production and influence business strategy to achieve environmental sustainability.

This chapter consolidates the findings of the research derived from the analysis and interpretation of statistical data. The research questions pertaining to technical optimisation to address ecological issues, energy efficient and alternative technologies, e-waste management, legislations and regulations to address environmental issues and green IT framework are answered.

4.2 RESPONSES TO RESEARCH QUESTIONS

The main findings of this research are discussed. Each question is followed by a discussion of the findings relating to that question.

4.3 DEMOGRAPHICS

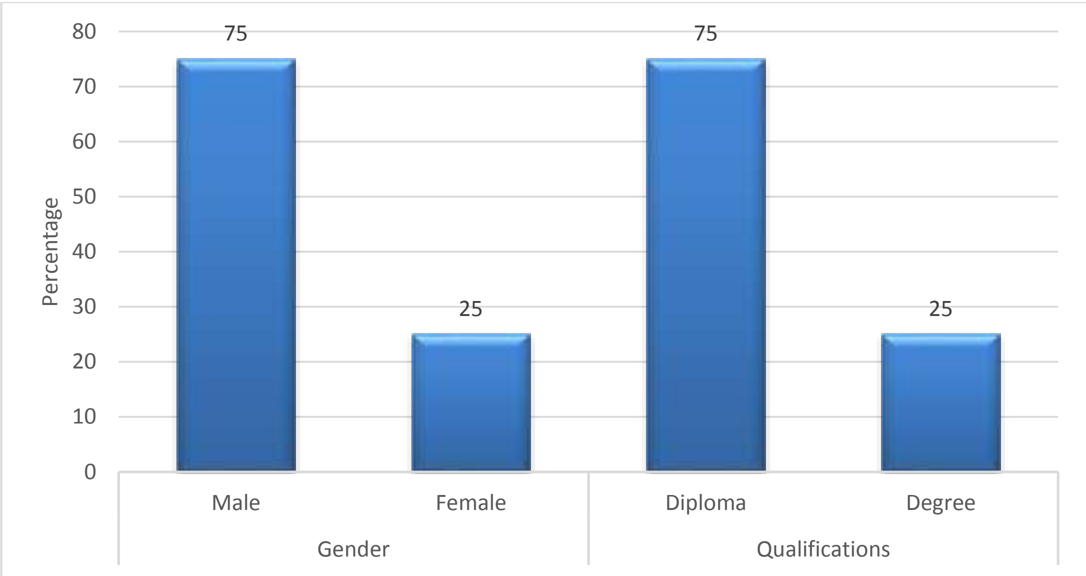

Figure 4.1 Distribution of gender and Qualification

As depicted in Figure 4.1, the employees were predominately males with 75% (6) while 25 % (2) were females. However, preference was not given according to gender. This figure reflects that the participants in the IT industry are dominated by males. This may be due to the inconsistent application of the employment equity legislation across the industry. About 75% (6) of them hold Diploma certificates while 25% (2) hold degree/ certificates. This indicates that majority of the participants are highly qualified and that education cannot be used as a differentiating factor, and working in the IT industry requires high level of education.

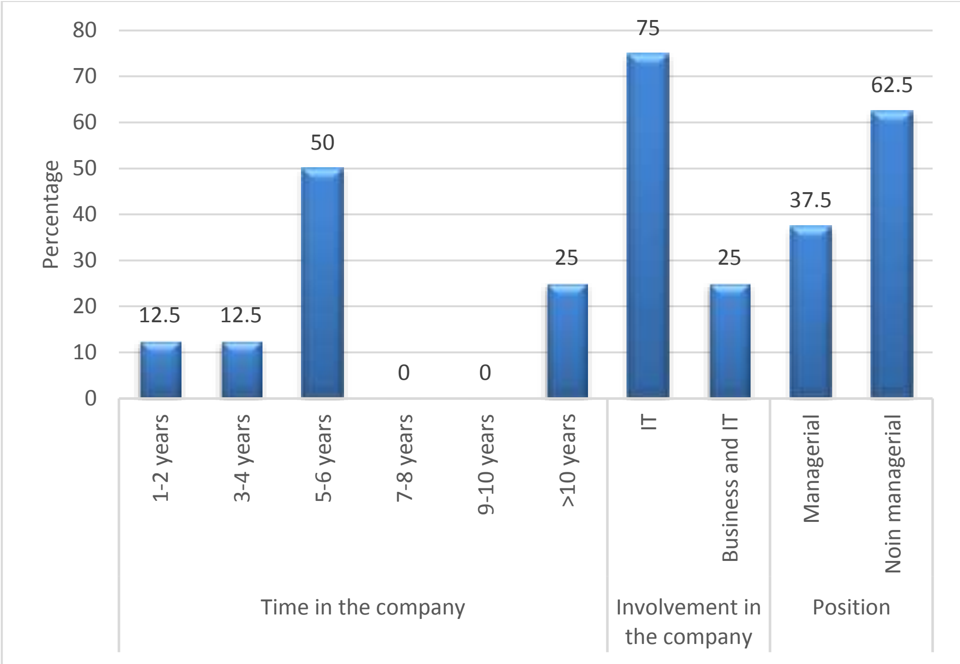

Figure 4.2 Distribution of Time in the Company, Involvement in the Company and in the Position

Figure 4.2 displays the distribution of Time in the Company, Involvement in the Company and the Position in the Company. It was discovered that half of the participants served the company between five to six years and 25% (2) served between seven to ten years while the remaining 12.5% (1) served between 1 to 2 years and 12.5% (1) served for three to four years. It was noted that the years of experience were slightly marginal. This result indicates that IT personnel's length of service is sufficient to execute their tasks in their organisations.

The data in Figure 4.2 indicate that the majority of the participants 62.5% (5) occupy non managerial positions while 37.5% (3) occupy managerial positions. This means that most of the participants are probably field workers. In the same way, the majority of participants 75% (6) are involved in the company IT while the remainder 25% (2) are involved in business and IT. In a nutshell, this means that most of the participants are conducting field work rather than managerial work.

4.4 DISCUSSION OF RESULTS

The following section discusses the results of the study.

4.4.1 Technical Optimisation to address ecological issues

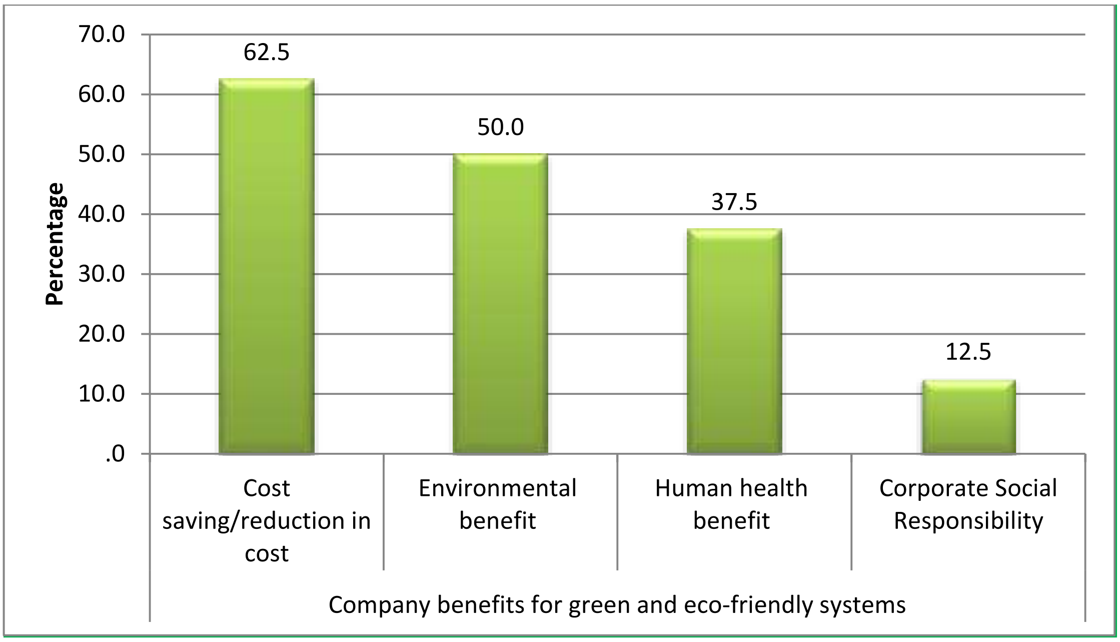

Figure 4.3 Company benefits for green and eco-friendly systems

Figure 4.3 illustrates the company benefits for green and eco-friendly systems. The data provide the view of the participants that the benefit for going green and using eco-friendly system for their companies is related to cost saving, environmental benefit, human health and corporate social responsibility.

Cost saving/reduction in cost: This was described by the participants to indicate that the adoption of Green IT is mainly about reducing the business expenses. The primary driver for Green IT adoption is mainly related to savings for companies. Therefore, according to the participants, Green IT is connected to cost effectiveness because it has the potential to create fertile ground for economic prosperity. Cost saving is the major reason why Green IT has gained a momentum. The reduction on IT spending and other financial incentives make Green IT a practical way for organisations to save money (Murugesan, 2011:39). This finding suggests that IT spending is impacting the sustainability of the organisations.

Environmental protection: The participants viewed the benefits for Green IT relating to the protection of the environment. Typically, this is because of the importance of preserving the environment by reducing IT activities that impact negatively on the atmosphere. In accordance with the participants' view, IT can play a significant role in reducing the impact of human activities on the environment by utilising environmentally sound IT activities. This finding shows that Green IT is connected with the sense of environmental awareness which is a concern for the ecosystem in which humans exist (Tomlinson, 2012:2). In this regard, IT can contribute to the reduction of carbon footprint and create a sustainable environment (Berthon et al., 2010:14; Molla et al., 2008:671).

Human health and wellbeing: The participants mentioned that Green IT adoption should be about the protection of human health and wellbeing because IT activities have the potential to cause adverse heath effect. In line with this finding, the participants indicated that environmentally sound IT should not have effects on the health and wellbeing of the people. In essence, environmental protection and health are intertwined or closely related. Environmental degradation negatively affects the health and wellbeing of the people (Robinson, 2009:189). This implies that ecological sustainability should connect the human needs without compromising the health of the ecosystem (Morelli, 2013:2) because it is the right of everyone to be in an environment that is not harmful to health or wellbeing (Constitution of the Republic of South Africa, 108 of 1996).

Corporate social responsibility: According to the participants, Green IT adoption is linked to corporate social responsibility. They felt that it is imperative for their companies to be Green IT compliant because this will ensure that their business operations do not violate the law. This lends support from previous literature that organisations are adopting corporate social responsibility with a desire to do well to the environment and comply with governmental regulations (Molla and Abareshi, 2012:93). This suggests that adopting corporate social responsibility prevent business operations in violating the law (Chong et al., 2010:86). Green IT implementation should provide value for businesses by being an enabler of efficient technologies and work practices. In the end, this will ensure corporate social responsibility by their companies. However, it was surprising to note that the participants did not link corporate social responsibility as benefit that relates to environmental protection. This could be attributed by lack of knowledge on corporate social responsibility.

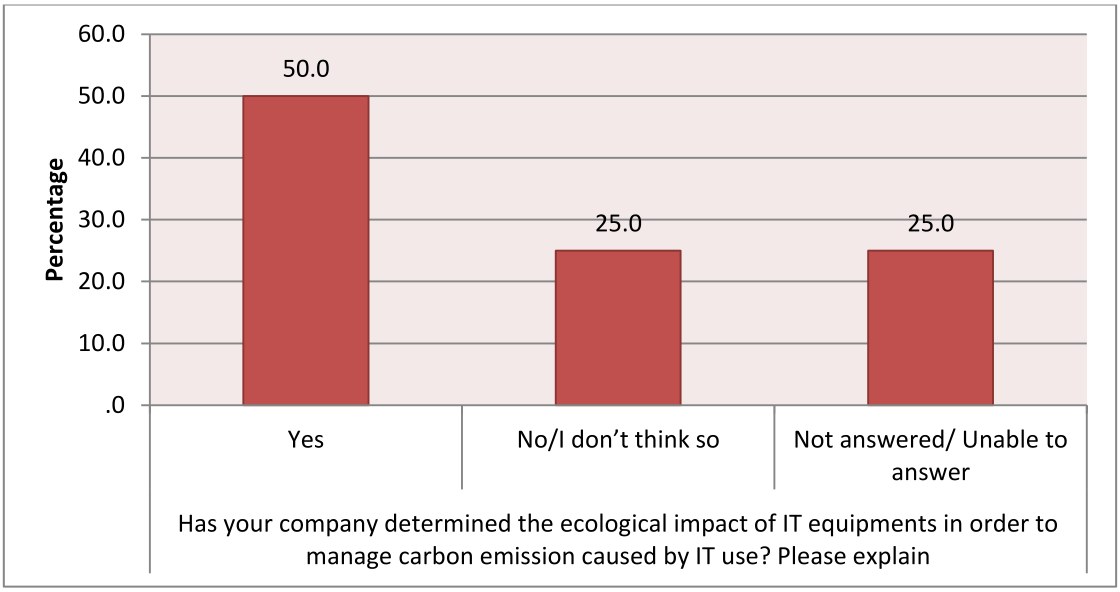

Figure 4.4 Managing carbon emission caused by IT use

The overall result in Figure 4.4 reflects the management of carbon emission that is caused by IT use.

Ecological impact: According to the participants, their companies are determining ecological impact of IT in order to manage carbon emission caused by IT use. They felt that ecological issues of IT products and service design need to be addressed in order to deal with pollution that is responsible for increases in atmospheric carbon concentrations and environmental degradation. The participants were of the view that determining ecological impact caused by IT has potential benefits for their companies. This confirms the previous findings that ecological impact caused by IT product is the driving force for Green IT implementation (Harmon and Auseklis, 2009:1709). However, some of the participants did not share the same sentiments because they did not regard their companies making efforts to protect the natural environment caused by IT use. They felt that their companies are contributing to the disproportionate burden of environmental degradation. This is surprising because green technology should address environmental impact of industrial processes (Lakshmi, Sarwani and Tuveera, 2012:1282). In contrast, some of the participants were uncertain while others did not provide answer to this question. This could be attributed to uncertainty or limited knowledge of the implication that IT operation is causing to the environment.

Table 4.1 Ensuring Business value

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Agree	3	37.5	37.5	37.5
Strongly agree	5	62.5	62.5	100.0
Total	8	100.0	100.0	

The result in Table 4.1 shows that Green IT is ensuring business value.

Delivery of IT service and business value: According to the participants, delivery of IT service and business value takes place without compromising the environment. They felt that determining the environmental and health impacts will provide value for their companies in the long run. Yet, they also felt that their companies should utilise green technologies that will help their companies to conserve natural environmental resources in order to correct the acceleration of carbon emission and achieve environmental sustainability. This is in support of Uddin and Rahman (2012:4079), that carbon footprint should be reduced to advance computer systems and prevent environmental harm. This suggests that organisations are required to adopt Green IT principles and focus on the sustainability of IT operations to create business value.

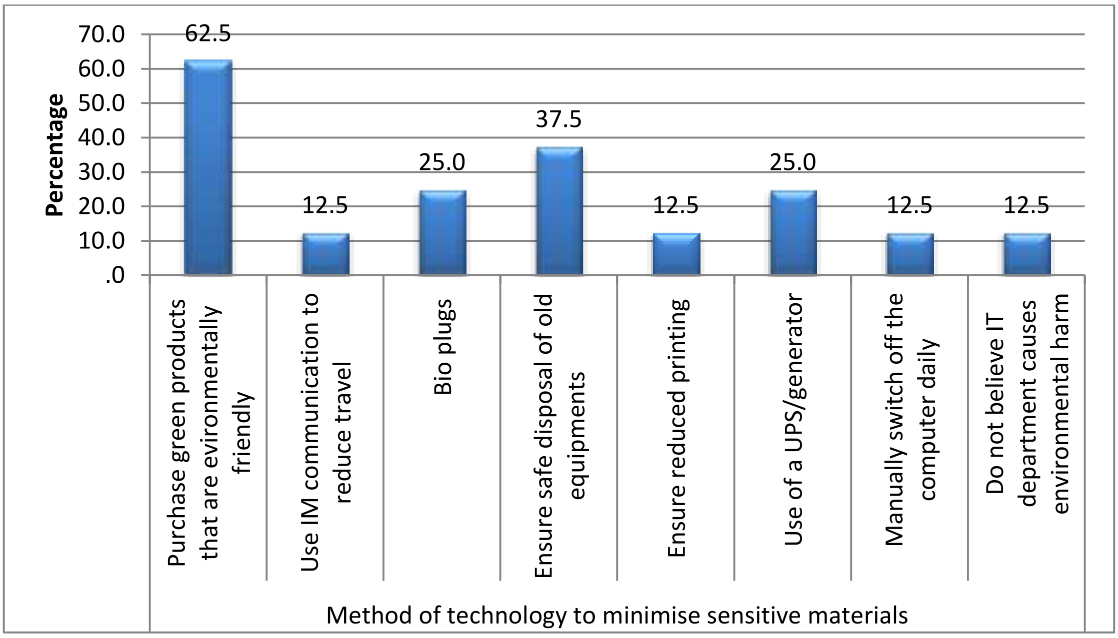

Figure 4.5 Method of technology to minimise sensitive materials

Figure 4.5 illustrates the method of technology that is utilised by the companies to minimise sensitive materials. The participants shared different views on different methods of technology used by their companies to minimise sensitive materials of IT products that impact the environment.

Green products purchase: The participants viewed purchasing green products that are energy efficient and environmentally friendly as essential for their companies to minimise harmful environmental impact. The selection of green products involves making trade-offs between environmental impact. The purchasing of green products is beneficial for the companies to reduce harm to the environment and provide a sense of environmental awareness. This lends support to previous findings in literature that the benefits of green products are expressed in terms of money, risk or brand. Therefore, it is essential for organisations to choose more energy efficient and environmentally friendly products that have Energy Star and Energy Star or Electronic Product Environmental Assessment Tool (EPEAT) ratings when buying IT products (Zhang and Liang, 2012:1000). This implies that organisations will save money and reduce the environmental impact because green products use less energy resources. The adoption of greener technologies helps the organisation to conserve the natural environment and resources (Sinha, 2011). It is evident that organisations are triggered by the environmental impact caused by IT products to adopt greener technologies (Zhang and Liang, 2012:1000).

IM communication: The participants mentioned that they are utilising IM communication in order to reduce travelling because travelling contributes to environmental damage through carbon emission. Therefore, according to the participants, investing in IM communication has the potential benefits for their companies in reducing environmental harm. The use of telecommunication, teleconferencing and videoconferencing technology plays a vital role in carbon foot print reduction. This is consistent with Harmon and Auseklis (2009:1707) that ecological issues of IT products and service design need to be addressed to deal with atmospheric pollution. Ramayah et al. (2013:247) believe that organisations are adopting eco-sustainable approaches in order to abate pollution and protect the environment. These suggest that the cars are consuming a lot of energy on the road thus causing environmental impact. However, IT can bring new hope to the organisations through shared information, online connection, electronic communication and video conferencing. These types of communication tools not only allow people far away from each other to work together, but they reduce environmental impact people would normally cause resulting from travelling.

Bio plugs: This was described by the participants as a method of technology utilised by their companies to reduce or minimise sensitive materials. This type of technology supports energy efficiency and helps in reducing the impact caused by IT products/equipments. This shows that efforts are being made by organisations to reduce consumption of energy by launching a programme in support of energy efficiency. It is acknowledged by Vine and Hamrin, (2008:467) that the modern IT systems provide more computing power per unit (kWh) thereby reducing energy consumption of computing power. Therefore, energy efficiency should be improved through the design and use of advanced technologies (Andreopoulou, 2012:1).

Safe disposal: According to participants, safe disposal of old pieces of equipment is an important factor to minimise harm to the environment because improper disposal of obsolete IT equipments is contributing negatively to the environment. They felt that effective and efficient procedures in managing e-Waste should be developed and implemented. This finding indicates that special handling is required to dispose of and recycle computers and other hardwares. Previous studies revealed that about 80% of electronic pieces of equipment that are highly toxic are discarded in unsafe and irresponsible manner and end up in the landfills (Hogan, 2011:9-10). This suggests that special measures should be developed to ensure safe disposal of e-Waste (Mingay, 2007).

Printing reduction: This was viewed by the participants as a contributing factor to escalating business costs and thus contributing to high energy consumption. According to the participants, the reduction in printing will minimise environmental harm and will contribute significantly to the business profit margins. This confirms previous findings in the literature that printing contributes to increased carbon footprint. Thus, the reduction of printing will save trees and the ecosystem. This is because about 90% of paper comes from the trees and in most instances the trees are not sustainably harvested (The Editors, 2009:8). This suggests that moving to a paperless system eliminates a large portion of waste in the workplace and has the potential to save money and reduce on carbon footprint. Therefore organisations should consider distributing information electronically rather than printing it. The underlying reason is the growing demand and use of IT resulting in high energy consumption. Thus, reducing paper will ensure protection of the environment (The Enterprise Management Associates, 2008:2). This implies that organisations should invest in green strategies to reduce existing energy consumption by configuring printers and using less paper and ink.

Use of UPS and generator: This was described by the participants as a measure to provide emergency power to a load when the input power source/main fails. They felt that their companies should find alternative clean resources to improve energy efficiency through the design and use of advanced technology to achieve environmental sustainability. Then again, they also viewed the use of Uninterruptible power supply (UPS) and generator preventing possible power interruptions. According to them UPS allows computers to keep running for at least a short time and offer protection from power surges. This is in agreement with the study conducted by Jenkin, Webster and McShane (2011:18) that energy is wasted by using inefficient technologies and poorly designed systems. In light of this statement, energy efficiency should be improved through the design and use of advanced technologies (Andreopoulou, 2012:1). This suggests that carbon neutrality can be achieved by using alternative energy sources and carbon sequestration (Chowdhury, 2012:636-639).

Manually switching off computers: This was described by participants as a factor that helps in reducing or minimising environmental impact that is caused by IT use. According to the participants, this also helps in preventing computers from crashing and reduces energy consumption. They felt that this method is important because it is helping their organisations to reduce on environmental harm. Furthermore, manually switching off computers will prevent data corruption in files and crushing. Utilising this method prolongs the span of computers and conserve energy. The evidence found in the study indicates that turning off computers and printers will save energy. This is because personal computer (PC) and computers that have been switched off still draw on average 20 watts of power. Therefore, it is essential to turn off computers and peripherals when they are not in use to conserve energy (Zhang and Liang, 2012: 1001). This suggests that the use of IT resources should be energy efficient and cost effective because the primary focus and practices of Green IT is to save energy and reduce or minimise environmental impact.

IT not causing environmental harm: It was mentioned by the participants that their IT operations were not contributing to environmental harm because they believed that their companies are making efforts by utilising various methods of technology to ensure the reduction or elimination of sensitive material of IT products that influence the environment. IT activities contribute negatively to the environment. The author believes that the participants have limited knowledge on Green IT. This is surprising considering that IT harms the planet and people. Murugesan (2008:24) confirms that IT is contributing to environmental problems. This suggests lack of knowledge or understanding of Green IT.

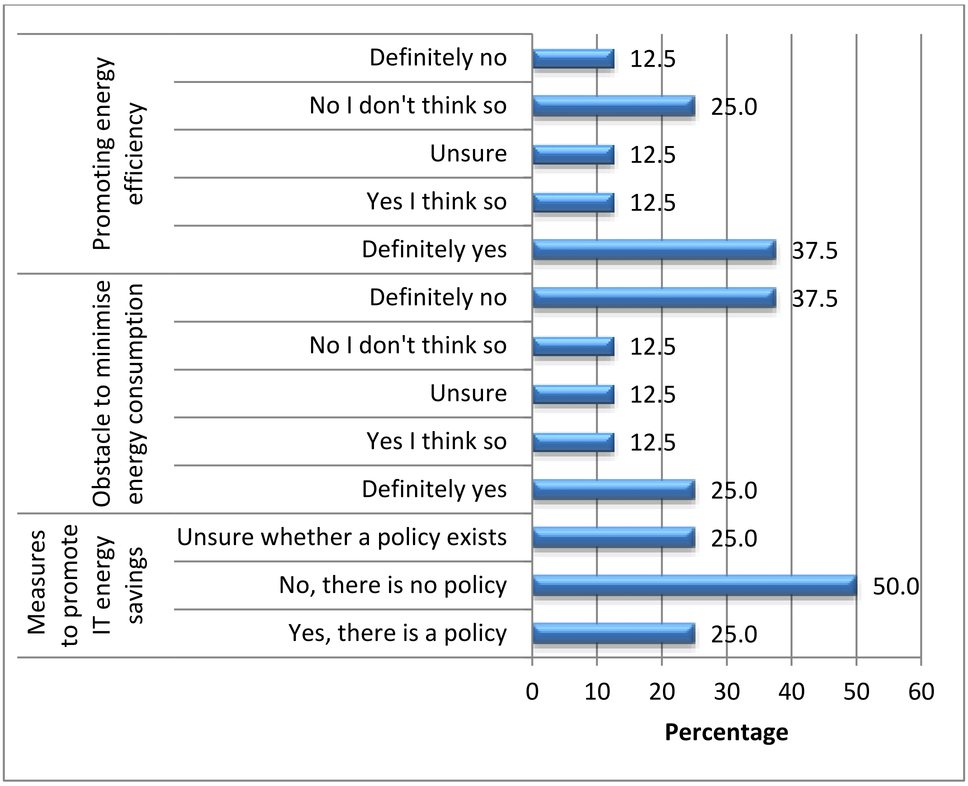

Figure 4.6 Energy efficient and alternative technologies

Figure 4.6 demonstrates views on energy efficient and alternative technologies

Promoting energy efficiency: The participants specified that they analyse the costs that have implications to their business with the intention of improving energy efficiency because IT equipments consume lot of energy when they are not in use. They felt that it is essential for their companies to search for energy efficient products in order to reduce the business operational costs. Furthermore, they also felt that if the companies are not analysing costs this will eventually affect their financial trade-off. Therefore, analysing the business cost should be continuously evaluated and monitored. This implies that improving energy efficiency will reduce environmental impact and eventually save the organisations money (Talebi and Way, 2009). Therefore, energy efficiency best practices are likely to realise significant energy and power savings for organisations (Albertson, 2008:8).

Obstacle to minimise energy consumption: According to participants, they are not receiving appropriate training including their managers regarding measures to reduce/minimise energy consumption that is caused by IT operation. Training is vital for the organisations that have specific goals in improving energy efficiency. Training is of benefit to the organisations because it develops the skills of personnel and can encourage energy savings. Therefore, it should be thoroughly explored and implemented to enjoy endless benefits of Green IT. These finding show how unprepared the organisations are and illustrate that training need to be conducted. As such, IT professionals are moving towards Green IT with the aim of developing IT activities in a sustainable manner to combat environmental problems and protecting company interest (Hanne, 2011:424). Thus corporate governance goal is intended to build a synergistic link between workers and the organisation, thereby protecting company interests (Badenhorst, 2009:5).

Measures to promote energy savings: The participants mentioned that they have policies in existence that seek to promote energy savings. IT policy was stated as having the ability to articulate organisational values, strategies and providing guidance for the organisations in decision making. They felt that energy conservation translates to energy savings because IT is the driver for energy savings and innovation. In reality, IT has become the driver for energy saving and innovation. However, a large number viewed that their companies do not have IT policy while others were uncertain. They felt that their companies should make effort to develop IT policy in the most effective manner in order to promote energy savings. This is a surprising finding considering that IT policy is a fundamental tool for enforcing ecological issues, thereby ensuring organisational compliance and energy savings (Chen, Boudreau and Watson, 2008). This suggests that there is resistance to change for the organisation and this is one of the roadblocks to Green IT adoption.

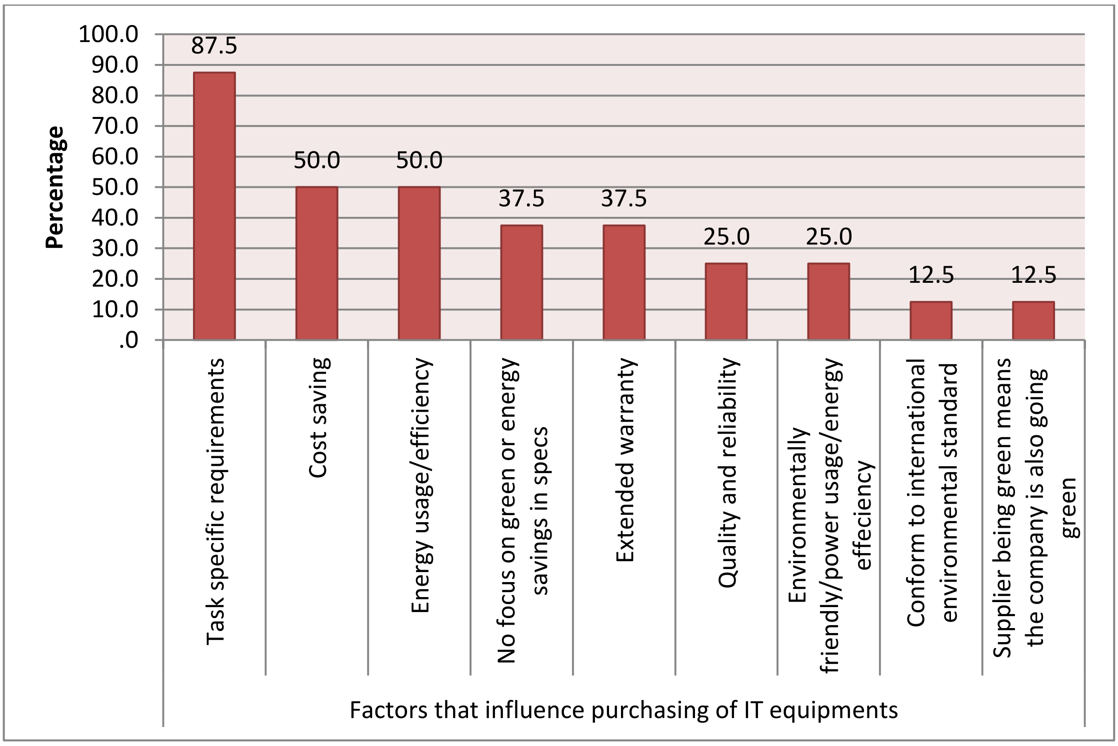

Figure 4.7 Factors that influence purchasing pieces of IT equipments

Figure 4.7 shows the factors that influence purchasing pieces of IT equipment and are listed as follows:

Task specific requirements: These were described by participants as important factors that influence the purchasing pieces of IT equipment by organisations. According to the participants it is not unusual for their companies to replace old computers with new ones. This replacement of computers with new ones helps in energy conservation and preservation of the environment. The use of task specific requirements ensures that work is complete successfully. The evidence found in the study confirms that the replacement of older pieces of IT equipment with new ones is a common practice by organisations that wish to promote economic activity (Fairweather, 2011:71; Kurp, 2008:13). This suggests that organisations are looking for ways to make their product more energy efficient which implies favouring the green concept and economic prosperity (Mattern, Staake and Weiss, 2010).

Cost saving: This was indicated by the participants as a determining factor for purchasing pieces of IT equipment. They felt that investment in renewal energy is essential because it will result in competitive returns for their business and will reduce costs. As reported by Walker and Cass (2007:458-467) the primary purpose of IT is to make business more productive and efficient and eventually saving money. This implies incorporating greater use of renewal energy technologies to mitigate climate change and reduce on energy cost. Investment in renewal energy will result in competitive returns in some of the market conditions.

Energy usage/efficiency: This was described by participants as the primary factor that influences their purchases. They felt that the business should find alternative ways to improve energy efficiency through designing and using advanced technologies to preserve the environment. It is acknowledged by Uddin and Rahman (2012:4079-4092) that energy efficient technologies can cut down the business cost significantly. This is the primary reason for computer manufacturing firms for competing and use environmentally sustainable energy efficient technologies in their products and services. This suggests that energy is a major component for economic growth in organisations (Harris, 2009). The study revealed that the wide spread adoption of green office equipment is encouraged by Energy Star which helps with the reduction of energy consumption (Albertson, 2008:3).

Not focusing on green or energy savings: It was highlighted by the participants that their purchases are not focusing on green or energy savings because they buy without consideration of the green aspects. This finding was unexpected because changing the traditional way in which organisations do business and utilizing IT can benefit the environment (Lake, 2014). This suggests that organisations fail to acknowledge the benefits of Green IT implementation.

Extended warranty: This was pointed out by the participants as an important factor that influences purchasing because the warranty promises to repair or replace pieces of IT equipment if necessary. Therefore, the participants felt that the extension of IT product life is a significant green influence on the IT life cycle. According to them, the longer the IT product lasts the less impact it will have on the environment. This is agreement with Chakravarthy, Kumar and Ragav (2013:1) studies, that the extension of IT product life is a significant green influence on the IT life cycle. This suggests that warranty on IT product plays a vital role.

Quality and reliability: This was viewed as a significant element that influences purchasing because the companies are dependent on performance and reliability of their IT equipment. The quality and reliability ensures good performance of IT equipment. This suggests the need to reduce IT complexity to lower the energy costs, improve quality of service and business performance (Waiti and Koo, ND).

Environmentally friendly/power usage/energy efficiency: This was identified by participants as an important aspect that influences purchasing because pieces of IT equipment and activities have the potential to cause irreversible harm to the environment. They felt that it should be a life style for their companies to conserve and protect the natural resources. The study revealed that organisations are becoming environmentally friendly by restricting the use of toxic and flame-retardants by the manufacturer of electrical and electronic equipment (Sinha, 2011). This implies the prevention of pollution by developing and using environmentally friendly competencies with the aim of eco-sustainability (Molla and Abareshi, 2012:93).

Conformance to international environmental standard: This was viewed by the participants as an important influence in purchasing because their companies should comply with environmental regulations in order to address the environmental concerns that are caused by their IT products. They felt that their IT products should comply with applicable laws and other environmentally oriented requirements because it is important for their business. The evidence in the study points out that IT organisations are facing exclusion from major markets if their product does not comply and conform to the environmental regulations (Butler, 2010:2). Therefore, they should implement Green IT because it prepares them organisations for compliance with future regulations and certifications (Uddin and Rahman, 2012:4082). This suggests that legislation is a fundamental tool for enforcing ecological issues and ensuring organizational compliance (Chen, Boudreau and Watson, 2008).

Supplier being green: This was mentioned by participants as a factor that influences purchasing. The participants indicated that they only buy from suppliers that are going green because they believe that going green will eventually lead to environmental sustainability. This finding may be deemed worrying because going green is perceived as a potentially competitive advantage by companies to gain goodwill and consumer support (Hannel, 2014; Thibodeau, 2008:10). This finding suggests limited understanding of the Green IT concept.

Greening data centres: The participants were unsure of steps that their companies should take to green their data centres and reduce operational costs. According to the participants, the data centres are consuming a lot of energy and contribute to GHG and thereby exacerbate environmental concerns. This finding was unexpected considering that the interview was conducted with IT professionals that were perceived to have extensive knowledge on Green IT. Gartner (2007) believes that green process should begin at data centres in order to reduce energy consumption. The underlying reason is because green is connected with the sense of environmental awareness (Tomlinson, 2010:2). This suggests that organisations should strive to have efficient data centres that translate to energy savings through the use of renewable energy. In this regard, the data centres managers must consistently focus on the energy consumption and cooling issue of data centres to improve the operating costs. On the other hand, the Green Grid can be a resource for organisations looking for ways to make their data centres more efficient.

Not taking steps to green data centres: This was viewed by participants as something that does not take place within their companies. According to them, the cost of energy to run IT infrastructure is caused by the expansion of data centres. This is quite a shocking finding considering that the escalating energy consumption caused by expansion of data centres is gradually increasing to run the IT infrastructure resulting in environmental concerns (Khan et al., 2014:337). This suggests that operational cost of data centres will continue to increase and steadily impacting the business cost (Murugesan, 2008:28).

Environmentally friendly data centres: These were described by the participants as an important driver for energy efficiency and alternative technology. They felt that their companies are giving less attention to infrastructural issues that consume lots of energy because it is unaffordable. Again, the participants felt that the cost of energy should be analysed in order to maximise energy efficiency and minimise environmental impact caused by data centres. It is acknowledged by literature that many data centres are more than ten years old and reaching the end of their useful life. In other words they consume a lot of electricity (Uddin and Rahman, 2012:4078). As a result, the current energy consumption in data centres is contributing to annual increase of the GHG emissions (EPA Report, 2009). This suggest that making data centres more energy efficient can provide financial, environmental infrastructural benefits for organisations (Widjaja, Mariani and Imam, 2011). The reason is because the world is reliant on data centres, hence the increase in power consumption (Chawla, 2013:2).

Centralised servers: According to the participants, centralising the servers will benefit their organisations because servers consume energy even when they are idling. They felt that this will tackle environmental harm caused by IT use. This lends support to previous findings in the literature that the business needs are growing faster and the server level has increased along with performance, thus resulting in high power consumption. This implies that in order to adress energy consumption it important to relocate the physical servers to virtual facilities in data centres to tackle or minimise the carbon footprint (Kurp, 2008:12).

Minimise hardware: This was identified by the participants as a benefit for energy efficiency because they help to closely control and protect their data. According to the participants, their companies should be able to manage both the hardware and their data. Cloud computing options eliminate the need for having more hardware and gives rise to more energy efficiency. It is evident that the old computers and IT hardware are causing environmental problems. As a result, they should be minimised to achieve environmental sustainability Murugesan,2008:30). This suggests that energy consumption and waste associated with the use of hardware should be addressed by Green IT implementation (Jenkin, Webster and McShane, 2011:18).

Outsource data management: According to the participants, outsourcing their company data management will contribute to energy efficiency because data centres' energy is a primary concern for organisations since they generate IT related costs. They felt that their companies should align their IT business objectives in a manner that is cost effective since outsourced data centres allow maximum freedom and flexibility in their daily IT operations. This finding concurs with Chawla (2013:16) that the uses of cloud technologies are more efficient in comparison to the traditional data centres, and this has become the key driver for Green IT. This suggests that outsourcing data management is a viable option for organisations.

Environmentally friendly fire retardants: These were described by the participants as a benefit that will eventually reduce the possible impact of flammability in their companies. As reported by Sinha (2011), organisations are becoming environmentally friendly and restricting the use of toxic and flame-retardants by the manufacturer of electrical and electronic equipment.

Server virtualisation: This was mentioned by participants as an energy efficient technology because it is important to relocate servers to virtual facilities. They felt that in a way, this will minimise potential harm to the environment and increase productivity. Again, the participants felt that they have limited knowledge on greening data centres hence they outsource the management of data centres to external companies. According to them, outsourcing has its own challenges for their companies as well. It is acknowledged that many server computers run less than 30% percent capacity and are more effective than average desktop machines. This implies that data energy and emission costs are a concern in green IT analysis from small installations to massive facilities with thousands of servers and tens of thousands of associated workstations (Ruth, 2009:75). In contrast, designing energy efficient and environmentally sound components, computers, servers and pieces of cooling equipment comprehensively addresses the environmental impact of IT implying the adopting of Green IT (Chou and Chou, 2012:448). This suggests that server visualization can reduce the total physical server footprint (Kumar and Ragav, 2013:2).

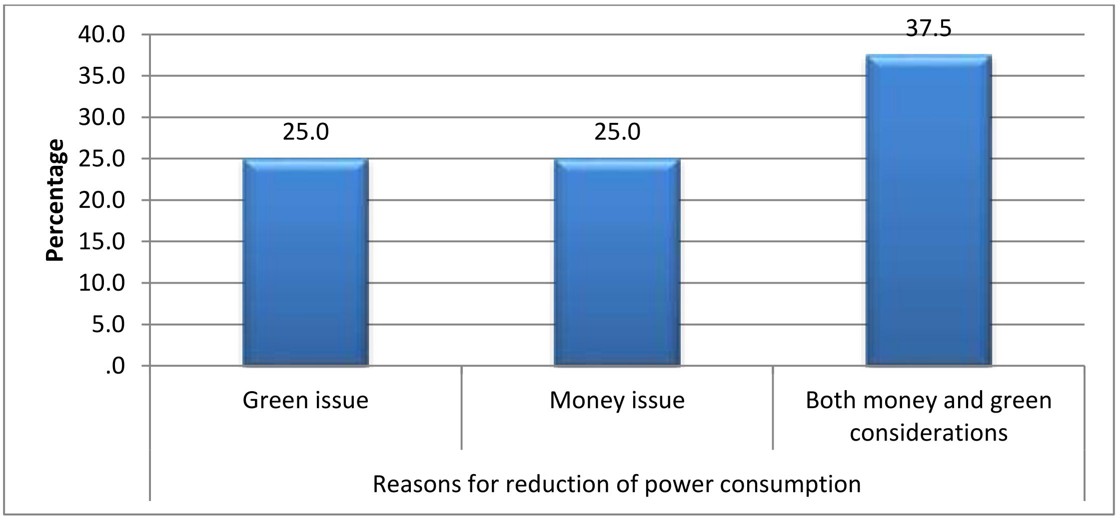

Figure 4.8 Reasons for reduction of power consumption

Figure 4.8 displays reasons for reduction of power consumption by companies as follows:

Green issue: This was mentioned by participants as a primary impetus for reduction of power consumption because of environmental concerns. According to the participants, it is important for their organisations to start saving energy and reduce on GHG emissions which will translate to financial savings. The participants felt that energy conservation is the corner stone for going green. This confirms previous findings in the literature that the reduction of energy use and carbon footprint implies going "Green", which leads to environmental sustainability (Talebi and Way, 2009). This implies that Green IT is a major contributing factor in minimising the pollution of the environment in order to achieve green environment (Chow and Chen, 2009:136). This suggests that Green technology offer more to the business dynamic than merely helping the environment.

Money issue: This was described by participants as the primary motivation for reducing power consumption in their organisations. According to the participants, the rising cost of energy has prompted their organisations to start searching for efficient technologies to reduce their business costs. Again, they felt that saving energy and resources can save their organisations money in the future. This is in agreement with the study conducted by Clarke (2009:19), that IT costs have become a green issue, hence organisations are moving towards Green IT to save money.

Both money and green: These were mentioned by the participants as the driver for Green IT. According to the participants, the locus of motivation for Green adoption is both money and green for their companies. They felt that reduction of power consumption will result in reduced costs and less harm to the environment. This is consistent with Talebi and Way (2009) that there is a growing consensus that improving energy efficiency will eventually reduce pollution and save money. In other words, saving energy and resources can actually save organisations money in the long run (Buckby, 2008).

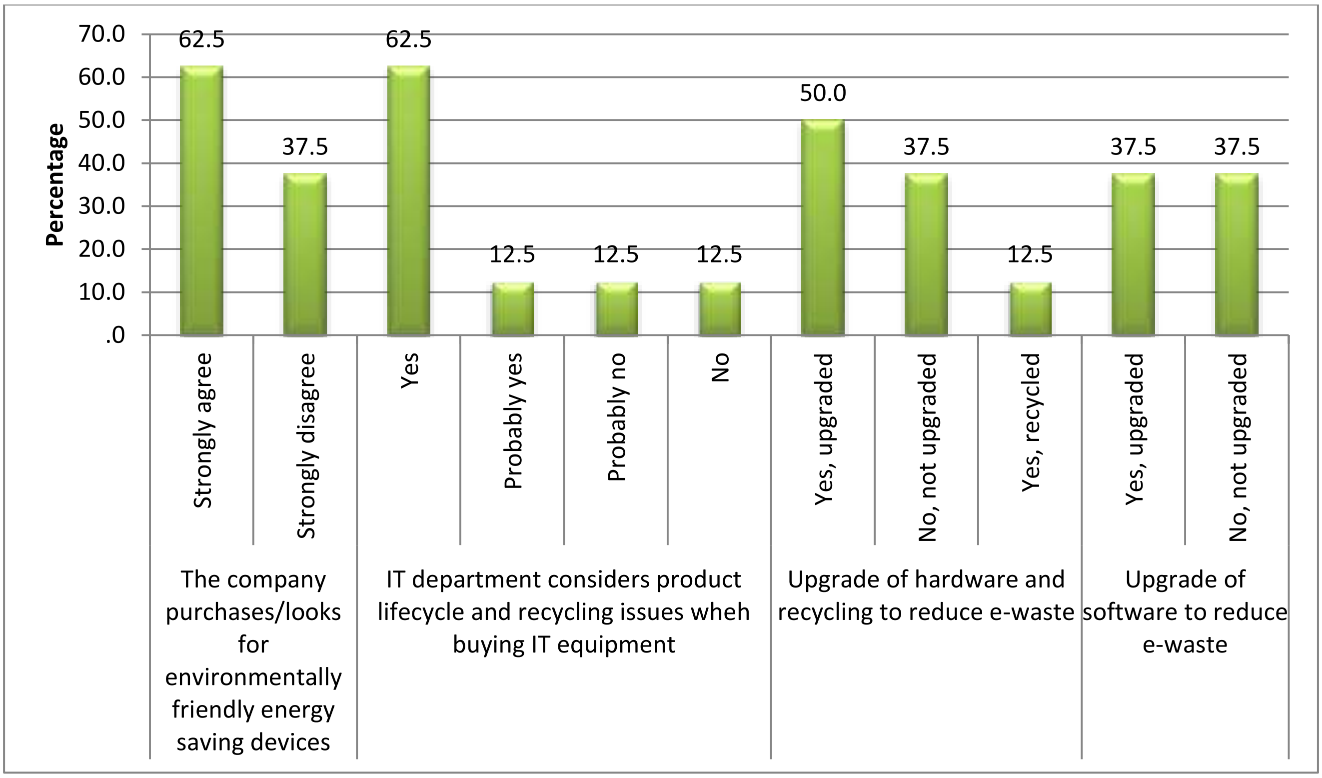

Figure 4.9 Purchasing process followed by the companies

Figure 4.9 illustrates the purchasing processes that are followed by companies.

Purchasing green products: The participants mentioned that their companies purchase/look for energy saving devices that have been manufactured in an environmental fashion. Green technology products are playing a major role in the buying process because they help their organisations to conserve the natural environment resources and lead to environmental sustainability. This lends support to previous findings in the literature that there is a need to protect the environment by adopting greener technologies (Zhang and Liang, 2012:1000). However, some of the participants mentioned that their companies were not purchasing energy saving devices. This finding concurs with Hannel (2014) that going green is a personal choice for organisations, which does not necessarily result in concrete economic or environmental benefits.

Considering IT product life cycle upfront: This was described by the participants as an important driver during the buying process of computers and peripherals for their companies because IT product life cycle is a prerogative in the buying process for their companies. As proposed by Vereecken et al. (2010), it is important to consider material extraction, production, and use, transport and end life cycle of the IT product when determining green technology and environmental impact (Vereecken et al., 2010). This suggests that IT life cycle management promotes stewardship and value for money (International Development Agency, 2010:3).

Not considering IT product life cycle: It was noted by the participants that their IT departments were not considering IT product life cycle when procuring computers and peripherals. According to the participants, the buying process in the companies is taking place in an unstructured manner. This finding was not expected, considering that technology is making business grow in a sustainable way because it offers the potential to save the planet if it is used and designed responsibly. This finding may also be deemed worrying considering that organisations are failing to recognize the role that IT can play in saving the environment (Roose and Jhaveri, 2009). It is evident that in practice the life stages of computer's life stages present environmental problems. Therefore, it is imperative to consider IT product life cycle (Widjaja, Mariani and Imam, 2011).

Upgrading software's and hardware's: This was described by the participants as a factor playing a role in controlling or reducing e-waste. Replacing softwares with newer or better version in order to update the system to enhance its characteristics is a benefit for the companies. They felt that upgrading or replacing the hardware/software provides an opportunity to increase the computer performance. Again, they felt that pieces of IT equipment that are not wanted should not be discarded but refurbished or upgraded to prolong the life span. It is acknowledged by Murugesan and Molla (2011:40), that organisations' spending on software are gradually increasing because of the evolution of the digital business. As a result, old computers should be refurbished and upgraded by reconditioning and replacing some electronic parts. In this regard, Green IT implementation adresses energy consumption and waste associated with the use of hardware and software (Jenkin, Webster and McShane, 2011:18). However, some of the participants mentioned that they were not really upgrading their softwares. This lends support to previous finding in literature that the management of computer software in the market is often an overlooked feature (Talebi and Way, 2009).

Recycling computers: This was mentioned by participants as a factor that is not utilised by their companies to prolong the life span of pieces of IT equipment and reduce on e-waste. The participants believe that their companies can recover precious metals and prevent hazardous waste through recycling. This substantiates previous findings in the literature that computer waste contributes to damaging not only the environment, but has serious consequences on human health resulting from carbon emission (Advanced Tropical Environment, 2012:10-26).

This implies that there is lack of adequate recycling in South Africa. This is acknowledged by the study conducted by Tocho and Waema (2013:199-100), that there is a little formal governance over e-waste and its recycling. This implies that South Africa is facing a challenge when it comes to e-waste recycling. As such, without a well-developed recycling programmes health risks are expected (Onwughara et al., 2010:294).

Software continuously upgraded: According to the participants their software is continuously upgraded to provide new version of programmes that have better stability to increase performance. In view of this finding, organisations are experiencing challenges with security threats, viruses, malware, hardware failures and software upgrades. This implies the need to constantly upgrading softwares and hardwares. However, some of the participants mentioned that their software was not upgraded. This finding is quite surprising considering the security challenges faced by organisations. This can be attributed by limited knowledge of Green IT.

Hardware repair: This was viewed by participants as a way to increase the life span of hardwares that are outside warranty. According to the participants, the life span of computers is too short and most of them become obsolete. Therefore, they are used for spare parts. Then again, the participants mentioned that their companies prefer to buy new pieces of IT equipment rather than increasing the life span beyond warranty. The evidence in this study points out that computers should be upgraded and refurbished to prolong their life span (Advanced Tropical Environment, 2012:11; Murugesan and Molla, 2011:40). This suggests that the shorter life span of electronic products is posing challenges to organisations.

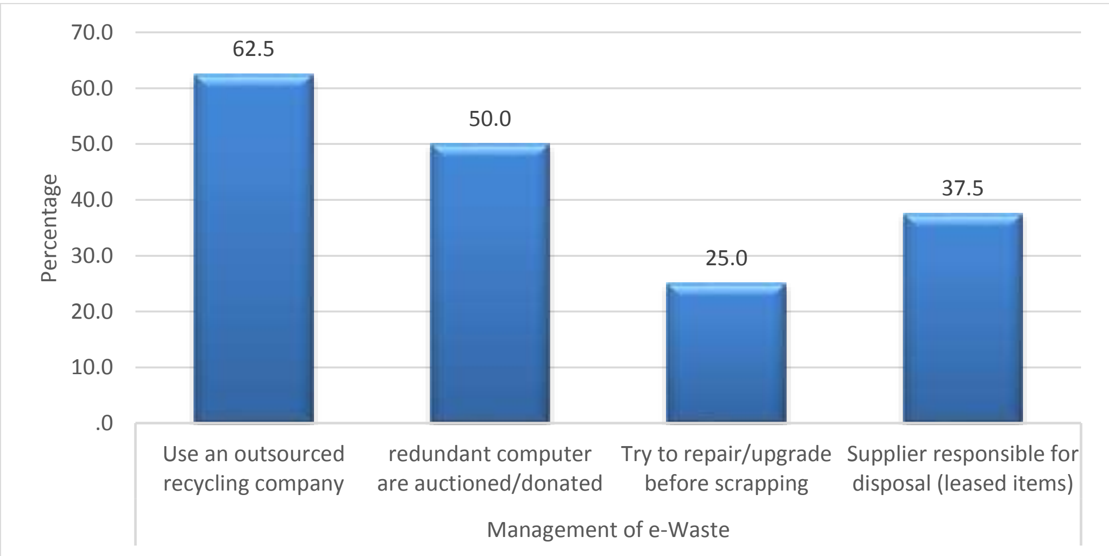

Figure 4.10 Management of e-Waste

Figure 4.10 displays the management of e-Waste by companies as follows:

Use outsourced recycling company: The participants viewed their companies as lacking capacity to manage e-waste through recycling. Therefore, their companies have management of e-Waste to maintain focus on their core business. This confirms the previous findings in literature that the management of e-waste suffers drawbacks (Tocho and Waema, 2013:100). This suggests that organisations are lacking waste removal infrastructure and technical capacities necessary to ensure safe disposal of e-Waste (Khurrum et al., 2011:2). In this regard, the incapacity of organisations on e-Waste has negative consequences on both human health and the environment.

Auction or donation of redundant computers: According to the participants auction and donation of computers is regarded as a way to manage e-waste. This confirms the previous findings of literature, that redundant computers should be auctioned or donated (Advanced Tropical Environment, 2012:96). This suggests that, e-Waste is poorly handled by organisations that do not have capacity to manage it, in terms of collection, storage, processing, destruction and disposal of non-recyclable e-Waste. It is believed by the author that auctioning and donation of redundant computers is not sufficient because it poses a further challenge of e-Waste management for the organisations receiving the donation or the buyers.

Repair or upgrade before scrapping: This was mentioned by the participants as another way to manage e-waste. They felt that their pieces of IT equipment should not be discarded but should be refurbished, upgraded, reconditioned and some of the electronic parts be replaced to prolong the life span of their IT equipment. This finding shows that the longer the IT product lasts the lesser the impact they will have on the environment due to disposal (Chakravarthy, Kumar and Ragav, 2013:1). In this regard, computers should be re-used, refurbished or upgraded (Murugesan and Molla, 2011:40).

Supplier responsible for disposal: The participants noted that they don’t have the capacity to manage e-waste. Therefore, they have transferred the responsibility to the supplier to ensure safe disposal of e-Waste. They felt that their companies are utilising minimal efforts to reduce e-waste because they repair and upgrade their computers occasionally. This finding implies that organisations should create an environmental management system that includes organisational structure, planning activities, responsibility, practice, procedure, processes and resources for developing, implementing, achieving, reviewing and maintaining environmental policy as indicated in the ISO 14001 standard to manage e-Waste (Chou, 2012:450). The author believes that the lack of e-waste management capacity in the organisations should be addressed to preserve the environment.

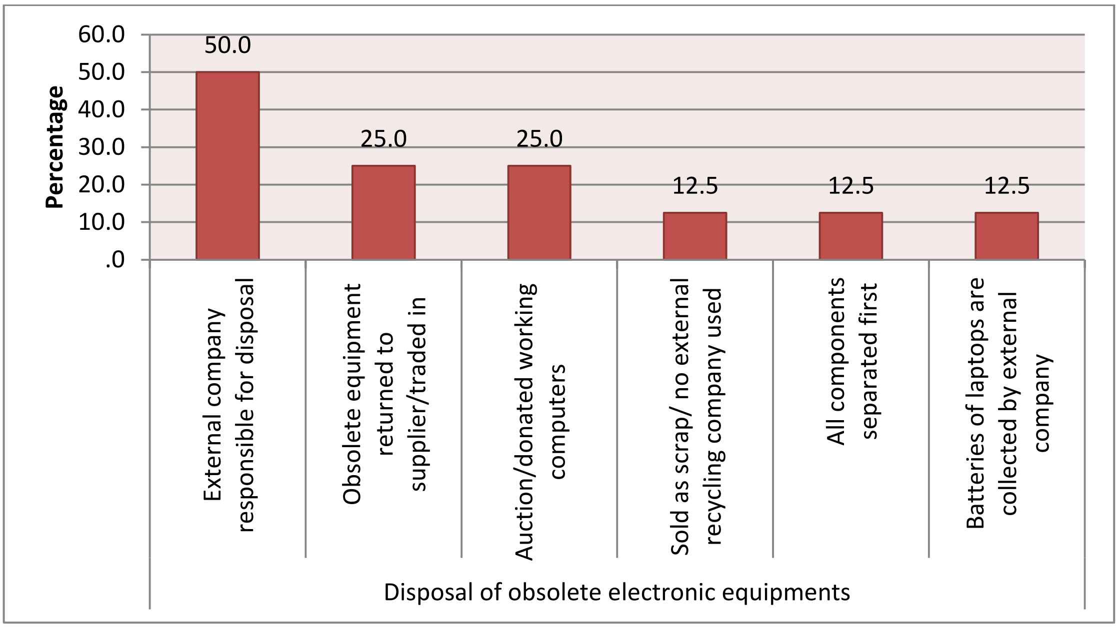

Figure 4.11 Disposal of obsolete electronic equipment

Figure 4.11 illustrates the disposal of obsolete pieces of electronic equipment by companies as follows:

External company responsible for disposal: The participants mentioned that an external company is responsible for disposal of their obsolete pieces of electronic equipment to prevent stockpiling of e-waste. According to the participants, they have limited knowledge on the disposal of obsolete pieces of electronic equipment. This finding lends support to Saphores et al. (2009:3) that organisations have stockpiled e-Waste because they don't know how to dispose of it. In this regard, institutional infrastructure for e-waste collection, transportation, treatment, storage; recovery and disposal need to be established to achieve environmentally sound management of e-waste (Tocho and Waema, 2013:100).

Obsolete equipment returned to supplier: The participants mentioned that they return obsolete pieces of equipment to their supplier, trade them in or sell them to achieve financial returns. They felt that e-waste is posing a challenge for their organisations. This is supported by previous findings in the literature, that organisations are adopting the Switzerland system that uses the ordinance on the return and tracking back the disposal of electrical and electronic equipment. The purpose of this ordinance intended to ensure that pieces of IT equipment are disposed of in an environmentally friendly manner (Dittke, 2009). This suggests that the system ensures that a person disposing of equipment shall return it to a retailer, manufacturer or importer or to a disposal facility.

Auction/donate working computers: According to the participants, auction/donating computers that are still working is another way of dealing with obsolete electronic equipment within their companies. It is evident that organisations are facing a challenges when it comes to e-waste management. As a result, they have opted to auction and donate computers as a way of dealing with obsolete pieces of electronic equipment (Advanced Tropical Environment, 2012:10).

Selling computers as scrap: The participants viewed selling of computers as scrap provides their companies with some form of financial gain. According to the participants, they don't recycle e-waste because they don't have the capacity to conduct or manage it. This is acknowledged by previous literature that organisations have limited capacity in terms of technological knowhow in complete recycling of pieces of electronic equipment that have reached their end of life period (Advanced Tropical Environment, 2012:9). Therefore, it is recommended that the use of various models which include take-back programmes, recycling based on products returned should be centred on the selling price (Linnell, 2009:78).

E-waste segregation: This was mentioned by participants as an important factor in disposing of any electronic equipment. According to the participants, they separate the components first before disposing of electronic equipment because discarded electronic gadgets contain harmful chemicals that have potential to contribute to environmental problems. Some of the participants mentioned that they collect segregate laptop batteries and utilise the service of external companies to collect them. Previous literature supports the segregation and recycling of e-Waste (Muzenda, 2013:79). This implies that e-Waste is not properly coordinated in organisations. In line with this finding, regulations that will make it mandatory for commercial and domestic producers of e-waste not to mix electronic waste with general solid waste should be promulgated (The Advanced Tropical Environment, 2012:96).

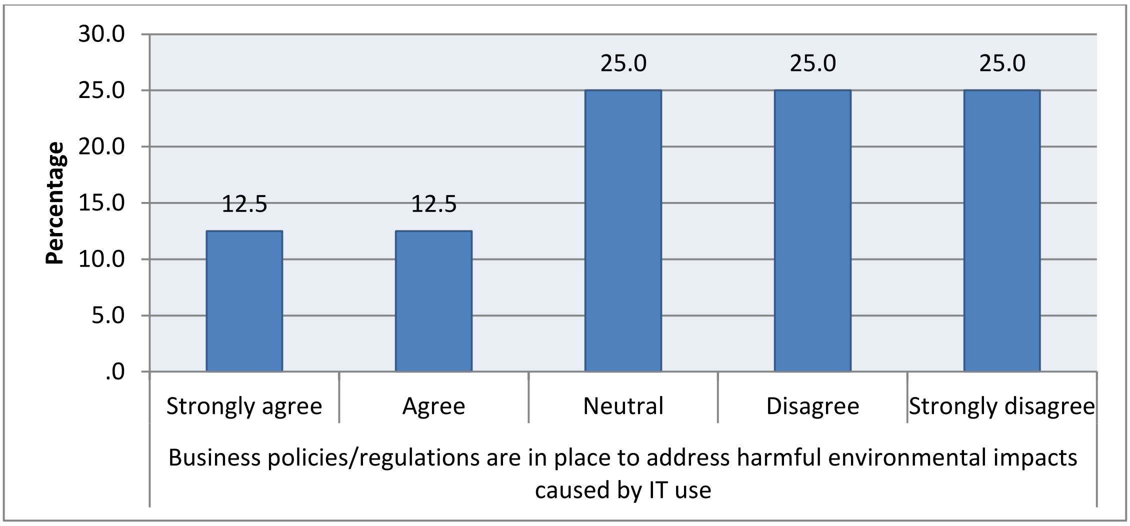

Figure 4.12 Business policies/regulations to address harmful environmental impact by IT use

The data shown in Figure 4.12 indicate that 25% (2) of the participants are of the view that their companies have business policies/regulations in place to address harmful environmental impact that is caused by IT use. This implies that the companies have established rules to conduct their business operation. Studies suggest that organisations should be encouraged and sometimes forced through laws and regulations to be ecologically responsive (Cai, Chen and Bose, 2013:491). However, 25% (2) are uncertain about the policies/regulations. This could mean that they are unaware of their business policies/regulations. In line with this finding, there is a need for stricter environmental regulations to improve corporate image of organisations (Chong et al., 2010:86). On the contrary, 50% (4) participants are not in agreement that they have business policies/regulations in place to mitigate harmful environmental impact that is caused by IT use. Research studies reveal that there is little or no effective enforcement of regulations to e-Waste management and disposal (Khurrum et al., 2011:2-3). This suggests that South Africa needs to respond and address the emerging issue of e-waste through the development of new regulations (The Advanced Tropical Environment, 2012:14). This could be attributed to the lack of policies/regulations from IT point of view to address environmental concerns caused by IT use. The research interprets that there is lack of policies/regulations from the companies that seek to address environmental impact caused by IT use.

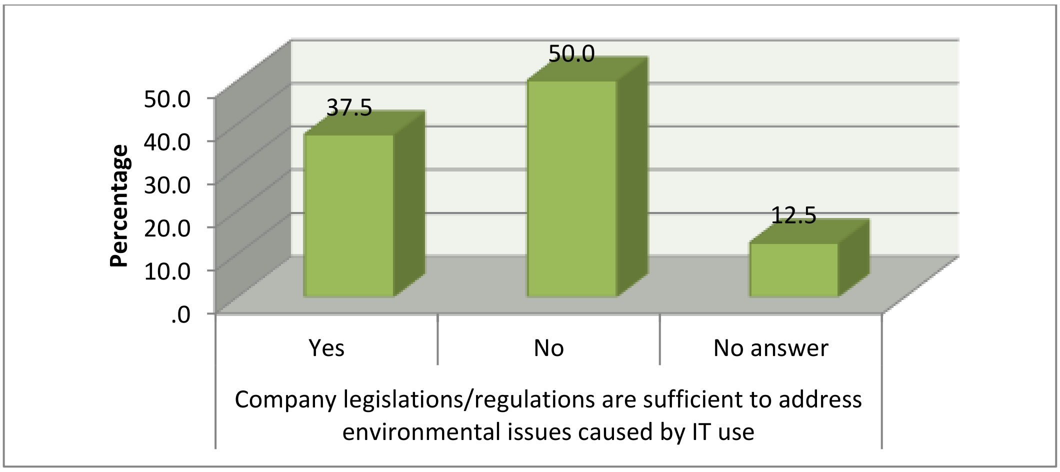

Figure 4.13 Company Legislations/regulations to address environmental issues caused by IT use

The result presented in Figure 4.13, shows that 37.5% (3) participants regarded their company regulation/legislations sufficient to address environmental issues caused by IT use. In Green IT context, legislation is regarded as an important tool for enforcing environmental issues, thereby ensuring organisational compliance (Chen, Boudreau and Watson, 2008). In contrast, half of them 50% (4) indicated that their regulations/legislations are insufficient to protect the environment from IT related activities, while 12.5% (1) did not answer. Previous studies reveal that many regulations have failed to address e-Waste management and disposal (Khurrum et al., 2011:2-3). The results suggest that the participants were uncertain about the issues that relate to the company regulations/legislations. The research interprets that the legislations are inadequate to address environmental impact caused by IT operation.

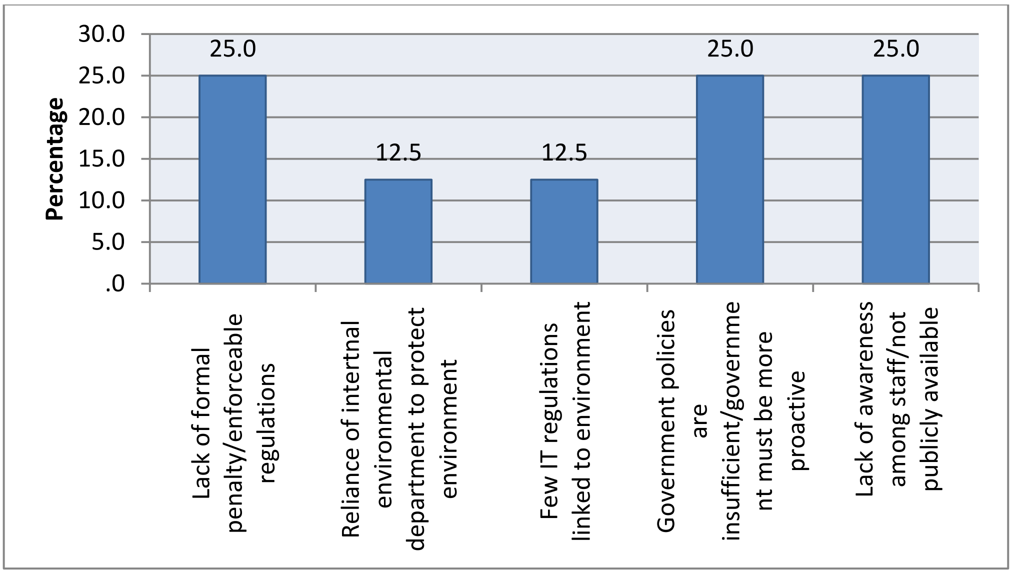

Figure 4.14 Company Legislations/regulations to address environmental issues caused by IT use (Narrative analysis)

Figure 4.14 provides additional information on legislations/regulations to address environmental issues caused by IT use that the author believes cannot be discarded and it contributes to the study. The issues are as follows:

Lack of formal penalty: According to the participants, there is lack of formal penalty and the regulations are not enforceable. This is because there is no legislation in South Africa that deals with e-Waste to protect the environment and improve quality of life. They stated that there is lack of policies that regulate handling and disposal of e-Waste. This implies that the regulation driving Green IT is inadequately enforced and is presenting a challenge (Dittke, 2009). In view of literature, many regulations have simply failed to address environmental problems (Khurrum et al., 2011:2-3). This can be attributed by the lack of specific legislation which is promulgated in South Africa to deal with e-Waste.

Reliance on internal environmental department: This was described by participants as a factor that ensures compliance in preservation of the environment. According to the participants, their companies should develop new ways to comply with environmental regulations in order to address environmental concerns caused by IT activities. It is acknowledged by studies that the disposal of e-Waste should be conducted in an environmentally friendly manner complying with all relevant environmental legislations (Shrihari, 2007:309-310). However, there is inadequate legislation globally for effective e-waste management (Kiddee, Naidu and Wong, 2013:1238). This suggests that Green IT should be implemented to prepare the organisations for future legislation and regulations that will benefit them to conform to environmental requirements (Sinha, 2011).

Few IT regulations linked to the environment: According to the participants few IT regulations are linked to the environment because there is deficiency in the company regulations and legislations. There is strong evidence that suggests that the key challenges experienced by South African organisations include illegal dumping, unlicenced waste management, overuse of landfills, insufficient waste minimisation, lack of waste information and legislation enforcement (Muzenda, 2013:79). In line with this finding, South Africa needs a dedicated legislation that deals with e-Waste to preserve the environment (Dittke, 2009).

Insufficient government policies: The participants viewed government policies inadequate because they are reactive rather than proactive. Perhaps not surprisingly, e-Waste is uncoordinated at national and regional levels of government because of insufficient government policies and regulations; therefore it is simple to throw electronic waste away (Murugesan, 2013). This suggests the importance of government to facilitate Green IT adoption.

Lack of awareness: Participants mentioned that there is lack of awareness among the staff members regarding the regulations because they are not publicly available. It was noted with concern that some of the participants did not provide any reason. This finding was unexpected considering that the lack of staff member awareness will result in non-compliance with environmental issues (Chen, Boudreau and Watson, 2008). This suggests that the organisations should increase awareness among the staff members about Green IT implementation.

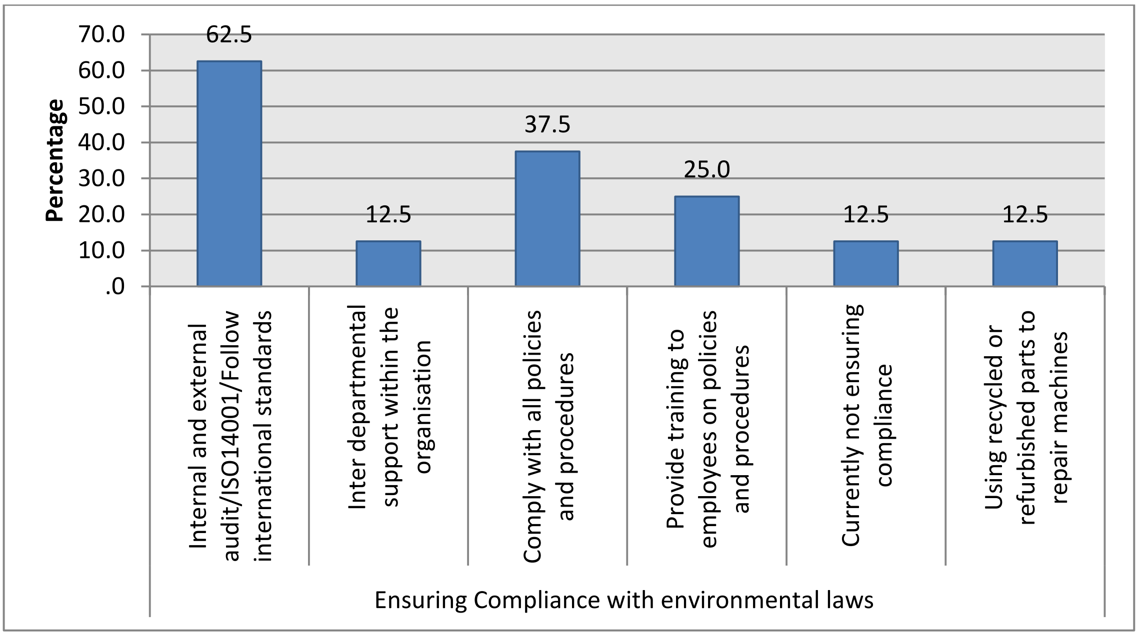

Figure 4.15 Ensuring compliance with Environmental Legislations

Figure 4.15 shows efforts by companies in ensuring compliance with environmental laws and they are as follows:

Internal and external audits: Participants viewed their companies as ensuring compliance with relevant environmental laws and code of practice for IT operations because they conduct internal and external audits utilising the international standards such as ISO 14001. The participants stated that their companies should comply with environmental regulations to create environmental sustainability. This is in agreement with previous findings in literature, that the implementation of ISO 14001 standard implementation can help the organisations to improve their environmental performance (Cater-Steel and Tan, 2010:110). This suggest the implementation of Green IT strategy because it includes conducting internal/external audits, monitoring and revising the business strategy (Murugesan and Molla, 2011:46).

Interdepartmental support: According to the participants, interdepartmental support within their organisations plays a big role in ensuring compliance with environmental laws and code of practice for IT operations. This lends support to previous literature that Green strategy can be developed by engaging stakeholders to ensure compliance with environmental laws (Murugesan and Molla, 2011:46).

Compliance with policies and procedures: The participants highlighted that they ensure compliance with all policies and procedures. This is acknowledged by previous literature on the King III report on corporate government in South Africa that there is a link between good governance, compliance with law and information management (Ngoepe and Ngulube, 2013:1). This implies that the implementation of Green IT will ensure that organisations comply with the regulations (Uddin and Rahman, 2012:4082).

Training on policies: Participants believed that training on policies and procedures should be provided to all employees. This suggests that training of employees is regarded as being beneficial for the organisations to ensure successful Green IT implementation. As such, training provides skills and ability required for effective job performance of employees.

Not ensuring compliance: Participants mentioned that their companies are not ensuring compliance because of insufficient legislation dealing with e-Waste. According to the participants, new regulation/legislation to manage e-Waste should be developed. This finding was not surprising because the obstacle to adressing e-Waste in South Africa is the lack of legislation that protect the public and the environment (Khurrum et al., 2011:3).

Recycling, refurbishing and repairs: According to the participants, recycling, refurbishing and repairing of computers in order to extend the life cycle of electronic products plays a major role in ensuring IT operations compliance. This is acknowledged by literature that IT products should be reused, refurbished or recycled to prolong their life span in an environmentally sound manner to prevent harm to the ecosystem (Advanced Tropical Environment, 2012:9; Chong et al., 2010:86). The underlying reason for recycling, refurbishing and repairs is because the growing IT sector is posing a threat to sustainable development because of the inevitable amount of obsolete, discarded, broken or abandoned IT products (Osibanjo and Nnorom, 2007:492). This finding suggests that recycling, refurbishing and repairs have the ability to extend the IT product's life cycle.

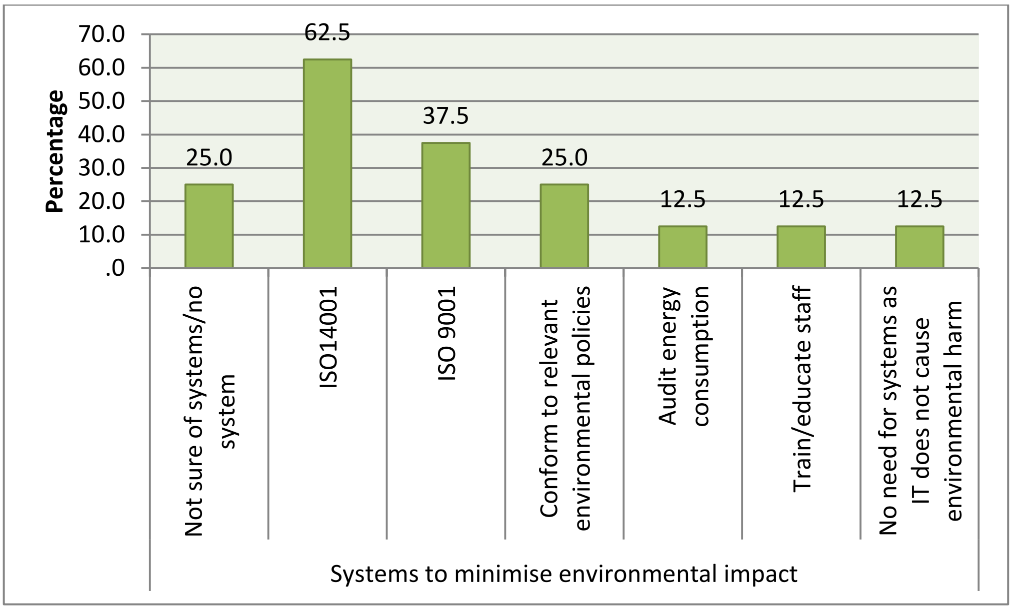

Figure 4.16 Systems to minimise environmental impact

Figure 4.16 illustrates the systems utilised by companies to minimise environmental impact and which are:

Uncertain of system/no system: According to the participants, there are no systems in place to minimise the environmental impact caused by IT use. They stated that there is lack of systems to address environmental impact caused by IT use. This finding was not expected because organisations are expected to create environmental systems to manage environmental impact caused by IT use (Chou and Chou, 2012:450). This suggests that the lack of system implies that organisations will continue to contribute to adverse environmental problems resulting from IT activities.

ISO14001 standard: This was mentioned by participants as a system that is utilised by companies to address environmental impact. According to the participants, ISO 14001 standard helps the organisations to improve their environmental performance. As reported by Cater-Steel and Tan (2010:110), ISO 14001 has the potential to help the organisations improve their environmental performance. The underpinning implementation of ISO 14001 provides a framework to forster the implementation of an enviromnental policy through classic management principles and the standard is compatible with GHG emission reduction goals (Boiral, 2006:326).

ISO 9001 standard: This was mentioned by participants as a system that is utilised by companies to improve on quality. According to the participants, ISO 9001 standard helps the organisations to improve their business performance. In line with this finding, the impact of environmental sustainability is receiving attention from IT professionals to achieve economic viability, quality and improve business performance (Chou and Chou, 2012:448). This suggests that organisations that are certified against the ISO 9001 standard are likely to enhance their business performance.

Conformance to environmental policies: The participants mentioned that they conform to the relevant environmental policies. They felt that it is important for their companies to create an environmental system to manage their e-waste. The evidence found in the study points out that Green IT has the potential to addresses energy concerns resulting from IT activities, regulatory compliance, carbon footprint and environmental sustainability (Enterprise Management Associates, 2008:3-4). In this regard, the adoption of Green IT will address the problem of organisations compliance with regulative, normative, cultural obligations and social responsibilities (Butler, 2010:2).

Auditing energy consumption: This was mentioned by the participants as an important factor to minimise environmental impact. This confirms previous findings in the literature, that what get measured can be managed. Thus monitoring, analysing and reporting energy and process flows can identify best remedial efforts. In this regard, organisations should conduct energy consumption audit because energy consumption is connected to GHG emissions (Khan et al., 2014:343). This suggests that organisations should develop measures to reduce their energy consumption. The use of software programs like local cooling can calculate the electricity usage of computers and adjust the settings to minimise it. This implies the implementation of Green IT which can help organisations to reduce energy consumption and protect the environment (Cai, Chen and Bose, 2013:493).

Train/educate staff: This was specified as a benefit to minimise environmental impact caused by IT use. This suggests that training or education of staff is deemed important in reducing the impact that is caused by IT use in atmosphere.

No need for system: According to the participants, there is no need for systems and their IT department is not causing any environmental harm. This is a surprise finding considering the impact that is caused by IT operations into the environment. There is evidence that suggest IT operations inherently have negative effect that is is likely to cause damaging consequence to the environment (Bose and Luo, 2011:1).

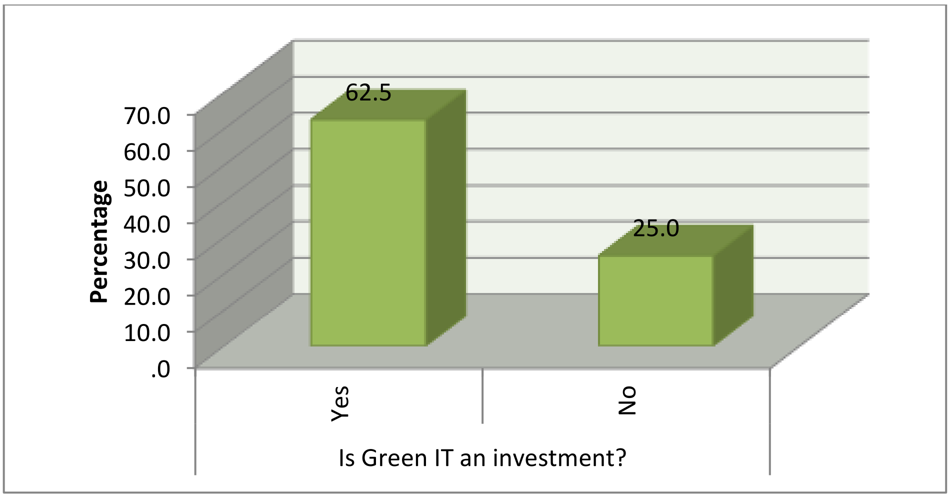

Figure 4.17 Green IT as an investment

The Figure 4.17 shows that the majority of the participants 62.5% (5) specified that Green IT is an investment for their company. Research studies reveal that the investment in renewal energy is essential because it will result in competitive returns in some of the business market conditions (Devarajan et al., 2009:107). This suggests that the companies are benefiting from Green IT implementation. In contrast, 25% (2) participants indicated that Green IT is not an investment for their companies. This implies that the companies do not derive any benefits from Green IT or they don't know the green concept. Unfortunately, 12.5% (1) participant did not provide an answer. This could mean that the participant was uncertain about the benefits of Green IT or lacks understanding about green the concept. The researcher interprets that the companies are reaping some benefits through Green IT implementation. However, some companies are still behind and missing out on the opportunities. This is particularly important now that organisations environmental credentials have real effect on the bottom line, and green investment can provide useful differentiator against a company's rivals and competitors.

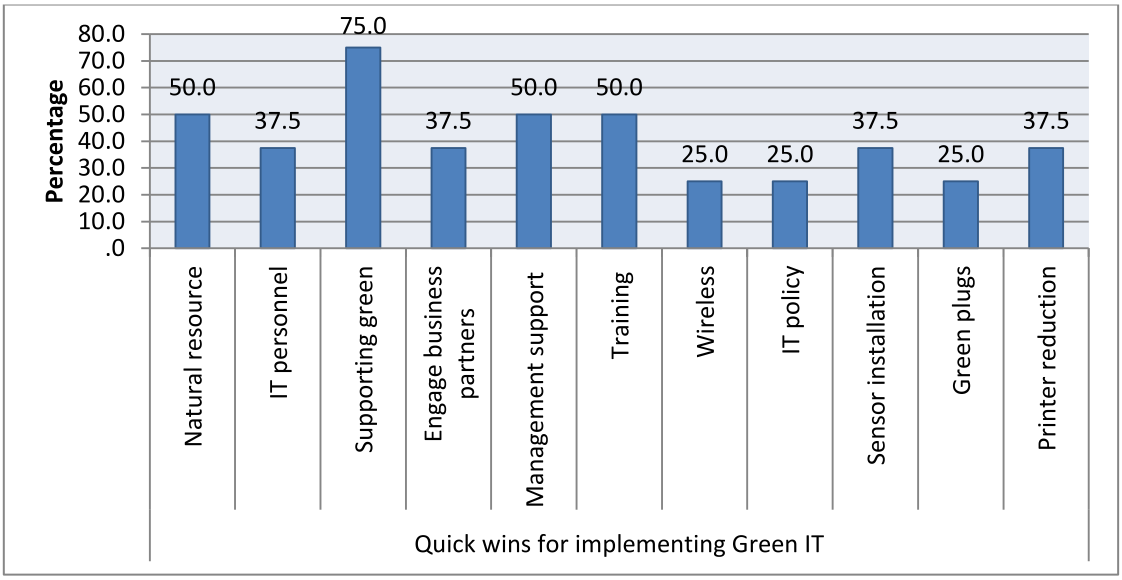

Figure 4.18 Quick wins for implementing Green IT

The Figure 4.18 illustrates the quick wins for implementing Green IT as follows:

Natural resources: These were mentioned by the participants as an immediate benefit for implementing Green IT. According to the participants, it is important to reduce carbon emission and increase in the use of natural resources. This is in agreement with the Constitution of the Republic of South Africa (108 of 1996) that requires the environment to be protected for the benefit of present and future generations, through the prevention of pollution and ecological degradation, and use of natural resources. This suggests that the use of natural resources can contribute to carbon reduction and is regarded as a quick win for Green IT implementation.

Recruitment of IT personnel: This was viewed by participants as an instant benefit that can deliver quick results for Green IT implementation. As expected, the impact of environmental sustainability is receiving attention from IT professionals to achieve economic viability and improved business performance (Chou and Chou, 2012:448). In this regard, IT professionals are now moving towards Green IT with the aim of developing IT activities in a sustainable manner to combat environmental problems (Hanne, 2011:424). This suggests that recruitment of IT personnel plays a major role in the successful implementation of Green IT.

Supporting green: According to the participants, green should be embraced or supported because it will provide quick wins for Green IT implementation. It is acknowledged by previous literature that one way of supporting green implies choosing more energy efficient and environmentally friendly technologies. This is because most of the technology associated with green living provides benefits to the environment (Lake, 2014).

Management support: This was viewed as an important element for instant benefit of Green IT implementation. For the Green IT implementation to be successful organisations are encouraged to develop a culture that supports a long term approach to strategy, because the benefits of adopting Green IT are not immediate (Campbell, Ratcliffe and Moore, 2013:132; Murugesan and Molla, 2011:41).

Training: This was noted as a factor that plays a significant role in the quick implementation of Green IT. As proposed by Berghout, Nijland and Powell (2011:755), information systems should be studied from conceptualization to development throughout the operations, in order to acquire deep understanding of IT management practices. This suggests that training will ensure successful implementation of Green IT.

Wireless: This was mentioned as an important factor that plays a role in the quick implementation of Green IT. This is acknowledged by literature that IT should contribute in solving environmental problems through technological change and green technology (Jorgensen and Jorgensen, 2009). This suggests that wireless is perceived being valuable in Green IT implementation.

IT policy: The development of IT policy was mentioned by participants as imperative to reap the immediate benefits of Green IT implementation. Studies support the use of nonrenewal resource and energy. The underlying reason being to increase economic prosperity because of the growing population (Welfens and Lutz, 2012:155). This implies the adoption of Green IT policy.

Sensor installation: According to participants, the installation of sensors can be an improvement that is visible and can provide immediate benefits for their companies for Green IT implementation. The lends support to previous findings in literature that it is important for IT to minimise environmental impacts and maximize energy efficiency through efficient use of IT resources (Chong et al., 2010:84). This suggests that IT devices consume energy and can be used to control energy by using movement sensors. In this regard, a programme in support of energy efficiency such as fluorescent light bulbs should be launched (Vine and Hamrin, 2008:467).

Green plugs: The participants mentioned that the use of green plugs can deliver quick results for Green IT implementation. For Green IT implementation to be successful, the use of energy efficient technologies such as green plugs should be utilized (Talebi and Way, 2009). This suggests that IT is playing a significant role to conserve energy by employing green plugs and contribute to sustainable growth,

Printer reduction: This was viewed by the participants as a key element for quick wins of implementing Green IT programme. As a result of the implications of high level energy consumption by IT activities and its contribution to GHG emissions contributing to climate change. It is recommended to consolidate printing of large number of printers into fewer central models to improve printing costs and improving energy efficiency in the use of IT devices to reduce environmental impact (Borggren et al., 2013:126).

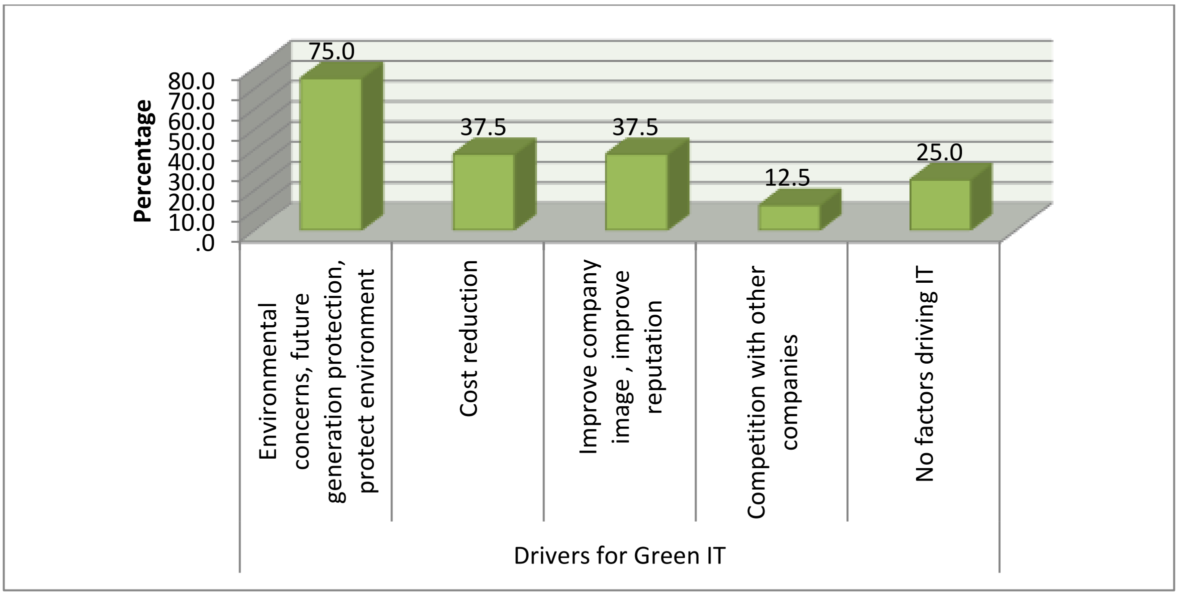

Figure 4.19 Drivers for Green IT

Figure 4.19 displays the drivers for Green IT which are briefly stated below:

Environmental concerns: Participants described this as a factor that drives the adoption of Green IT for their companies. According to the participants, the protection of the environment and promoting sustainability for future generations is important because there is growing awareness of sustainable development and environmental protection. This is in agreement with previous studies, that organisations have realized that ignoring negative impacts on the environment will be costly in the future. In this regard, they are developing new ways to enhance their competitiveness and comply with environmental regulations (Smith and Perks, 2010:2-3). This suggests that a system and programme that will help organisations to adress environmental concerns is required (Chowdhury, 2012:639). This means the adoption of green technology.

Cost reduction: This was identified by the participants as an important factor in the drive for Green IT implementation. According to participants, the cost of energy and environmental concerns has introduced challenges for their companies. Therefore, their companies are searching for efficiency and reduction of business costs. Previous studies suggest that the organisations should operate in a more ecologically friendly manner to embrace the opportunity of increasing IT efficiency and cost reduction through the implementation of greener IT solutions (Chou and Chou, 2012:449). This implies that the organisations in the computing environment are faced with challenges relating to costs of energy and environmental concerns (Paletta and Junior, 2013:70).

Improving company image and reputation: This was viewed by participants as an important driver for Green IT implementation. According to the participants, their companies are likely to experience improved reputation, trust and competitive advantage through supporting green. This is in agreement with previous studies that organisations are likely to experience improved reputation, trust and competitive advantage through Green IT implementation (Steenkamp, 2011:3). This implies that organisations should focus on environmental sustainability because of economic opportunities that are likely to strengthen their reputation and prevent adverse environmental issues (Smith and Perks, 2010:2).

Competition with other companies: The participants described the driver for green IT associated with competition amongst companies. According to participants, competitions have an influence on Green IT implementation. It is acknowledged by literature that competition, legitimation and social responsibility influence Green adoption (Kuo and Dick, 2009:83). In this regard, the implementation of Green IT implies accessing new sources of capital and identifying new market opportunities (Boiral, 2006:318).

No factors driving Green IT adoption: According to the participants, there are no factors driving the adoption of Green IT for their companies. This confirms the finding by Hannel (2014) that Green IT adoption is a personal choice for organisations, which does not necessarily result in concrete economic or environmental benefits. However, some felt that there is lack of motivation or limited understanding of Green IT adoption. Hence they are unaware about the reasons that drive their companies to adopt Green IT.

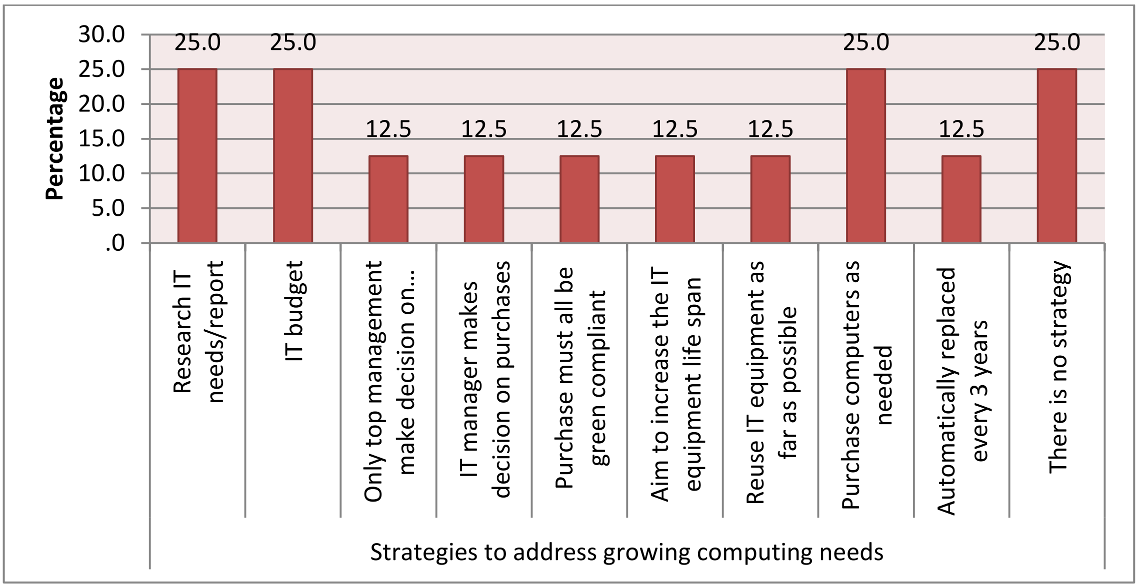

Figure 4.20 Strategies to address Computing needs

The result presented in Figure 4.20, shows the strategies that the companies utilise to address growing computing needs and are briefly explained:

Research IT needs: The participants pointed out that the strategy used by their companies to address business computer needs is linked to research of IT needs. According to the participants, the strategy provides clarity and focus for their companies. This in support of literature, that investing in research and the development of advanced technologies will ensure that the business meet the requirements (Uddin and Rahman, 2012:4083). However, there is little research conducted in business today on Green IT strategy (Green and McCann, 2011:446-461). This suggests that investing in research for IT needs is likely to impact the business performance.

IT budget: This was described by participants as playing an important role in addressing growing computing needs. According to the participants, IT plays a central role in achieving business results. This is consistent with literature that the total global spending on IT is projected to consistently rise which indicate a new growth cycle for market research (Gartner, 2008). This suggests that the current energy costs have become a major factor for IT managers because IT equipments account for 25% of total corporate budget (Harmon and Auseklis, 2009:1708). This implies that IT budget plays a significant role in Green IT implementation.

Top management making decisions: This was described by participants as an important driver to address growing computer needs. Management support was stated as a critical factor for company success. This supports previous literature that Green IT strategy can help top management to make decisions that have positive impact on the environment (Cai, Chen and Bose, 2013:493). This suggests that organisations should establish green strategy which is fundamental for organisations to make decisions (Olson, 2008:22).

IT manager makes decision on purchases: was pointed out by participants as a strategy to address growing computing needs. According to the participants, the IT manager has control over the budget. This is confirmed by previous studies that IT managers are responsible for purchases of IT equipments (Harmon and Auseklis, 2009:1708). In other words, the overall responsibility and accountability for IT related activities lies with the IT managers.

Purchases must be green compliant: According to the participants, the purchases must be green compliant because they have potential benefits for the company. This confirms previous findings in the literature that organisations should comply and conform to environmental regulations (Butler, 2012:2). The underlying reason is because the organisations have adopted corporate social responsibility which desire to do good to the environment, achieve profitability, satisfy stakeholders and comply with governmental regulations (Molla and Abareshi, 2012:93). This suggests that purchasing should take cognisance of the IT life cycle, including the opportunities for reusing and recycling when the IT products reached their end of life.

Aim to increase IT life span: The participants pointed out that their companies' strategy for addressing computing needs is about increasing the IT life span. They felt that IT equipments should be refurbished and upgraded to prolong their life span. This is in agreement with previous findings of literature that since the lifespan of IT products are very short, they should be refurbished, re-used or recycled in order to prolong their life span (Chong et al., 2010:86).

This suggests that increasing life span of IT equipments is logical to address computing needs within the organisations.

Reuse IT equipments: According to participants, the company reuses all IT equipment as far as possible in order to address computing needs. They felt that IT equipment should be reused to ensure more efficiency of resources and provide business solution for growing computing needs. This confirms the previous findings of the literature, that efficient use of resources is important for organisations through reuse of pieces of IT equipment (Terazono et al., 2006:1). In this regard, organisations should be encouraged to reuse, remanufacture and recycle IT used products in order to reduce harmful effects to the environment (Chung and Wee, 2010:466). This suggests that reusing IT equipment provides plausible benefits for computing needs.

Purchase computers as needed: The participants pointed out that their companies purchase computers according to business needs. In line with this finding, organisations are recommended to replace their old computers with new ones that are more efficient to become environmentally friendly (Kurp, 2008:13). This suggest that computers should be replaced or purchased when they are needed.

Automatically replace computers every three years: According to the participants, their companies automatically replace the computers every three years because the life span of computers is between 4-5 years. They felt that most of the computers become obsolete before losing capacity and they are used for spare parts. This is consistent with previous findings in the literature, that the life span of computers is between 4 to 5 years, and most of them become obsolete before losing their capacity and are cannibalised for spare parts (Advanced Tropical Environment, 2012:28). This suggests that organisations are frequently replacing their computers every three years.

There is no strategy: This was mentioned by the participants that there is no drive or impetus to address growing computing needs. This is a shocking finding considering that Green IT strategy support the crucial elements of organizational sustainability, environmental, economic and social (Chong et al., 2010:84). The absence of Green IT strategy does not provide value for businesses (Unhelkar, 2011:59). This implies that a holistic and comprehensive Green IT strategy should be developed by organisations to address computing needs (Murugesan, 2008:31).

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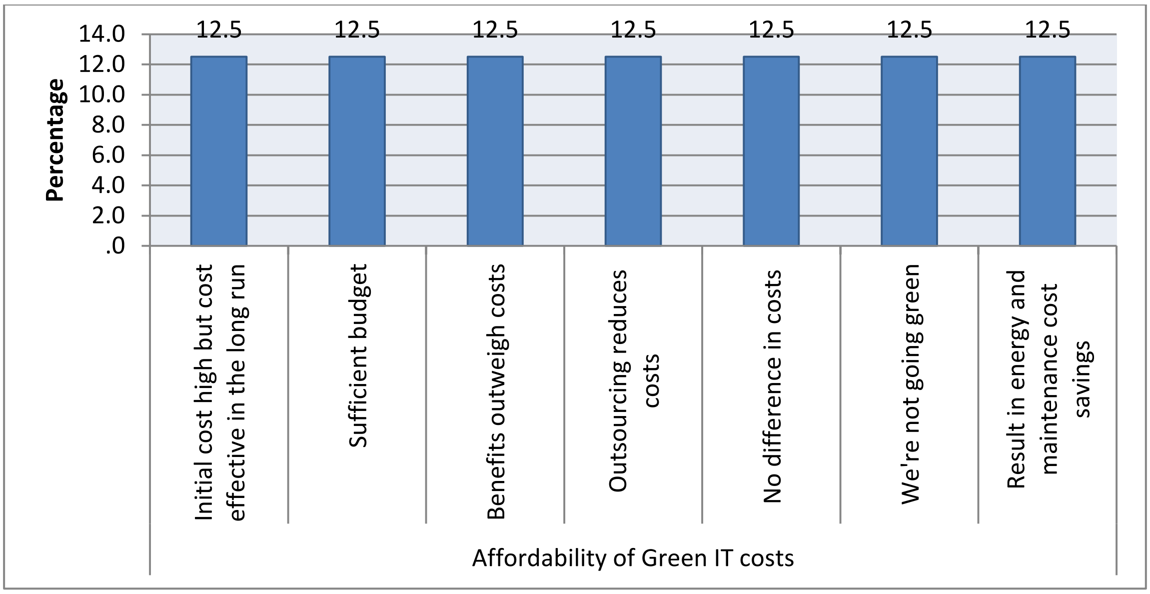

Figure 4.21 Affordability of Green IT

The majority of the participants 75% (6) pointed out that the cost of implementing Green is affordable for their companies. This is in contrast with literature, that the cost reduction gained by going green are not always enough to offset the initial upfront conversion costs (Lake, 2014). However, 12.5 % (1) did not agree on the cost of implementing Green IT. This finding is not surprising because some organisations perceive the implementation of Green IT unaffordable (Harmon and Auseklis, 2009:1708). This implies that the cost of implementing Green IT is regarded as being expensive. In the same light, 12.5% (1) participant was uncertain about the cost of implementing Green IT. This suggests that the cost factor is not determined by the company for Green IT implementation. The research interprets that the cost of implementing Green IT is affordable for the companies.

Narrative analysis

The participants provided some rich information about the costs for implementing Green IT for their companies as shown in Figure 4.21. These costs are briefly explained as follows:

Initial cost high: The participants viewed the initial costs for Green IT implementation very high but cost-effective in the long run. This confirms previous findings in the literature that the cost of going green is not always enough to offset the initial upfront conversion costs (Lake, 2014).

Sufficient budget: The participants described sufficient budget as the determining factor for Green IT implementation. This suggests that sufficient budget for IT operations are important for Green IT implementation.

Benefits outweigh the cost: According to the participants, the benefits of Green IT implementation outweigh the cost. This confirms the literature, that investing in Green IT will results in competitive returns in some of the business market conditions (Devarajan et al., 2009:107).

Outsourcing reduces costs: The participants described outsourcing as a way of reducing the cost of doing business. This suggests that outsourcing is regarded as the best way to reduce the cost of business.

No difference in costs: According to the participants there is no difference in the cost of Green IT implementation. This is a surprise finding considering that there is difference in the cost of going green which are not always enough to offset the initial upfront conversion costs (Lake, 2014). In contrast, some organisations perceive the implementation of Green IT unaffordable (Harmon and Auseklis, 2009:1708). This suggests that there is limited understanding of Green IT implementation in relation to the cost involved.

Company not going green: The participants pointed out that their companies were not going green. According to participants their companies do not see the value of Green IT adoption. This is a shocking finding considering that the earth and its natural resources is being jeopardised by industrial growth and IT activities contributing to climate change and affecting future sustainability (Cai, Chen and Bose, 2013:491).

Energy and maintenance cost saving: According to participants Green IT implementation results in saving of energy and maintenance cost. This is in agreement with literature, that it is important to reduce carbon and move towards energy systems that incorporate greater use of renewable energy technologies to mitigate climate change and cost reduction (Walker and Cass, 2007:467). Other participants did not provide reasons. This can be attributed to uncertainty or limited understanding of Green IT concept.

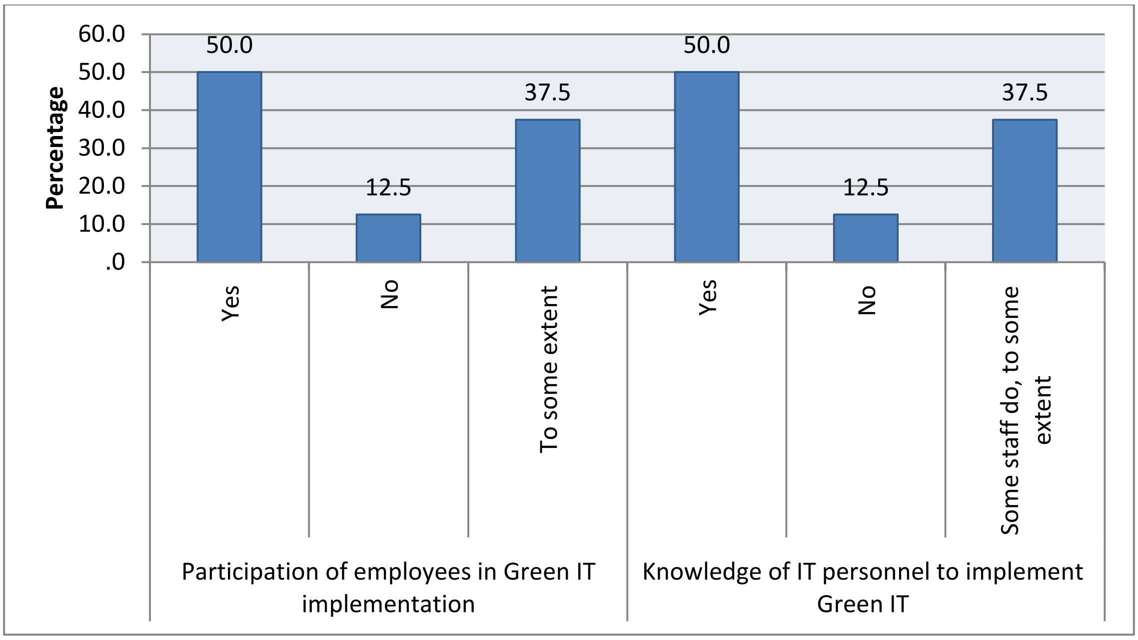

Figure 4.22 Participation and knowledge of IT personnel to implement Green IT

The result presented in Figure 4.22 shows participation of employees in Green IT implementation and knowledge of IT personnel to implement Green IT.

Participation of employees in Green IT implementation: It was mentioned by the participants that their companies involve them to make Green IT part of their company culture. The participants felt that Green IT implementation should be developed by engaging the relevant stakeholders. The review of literature suggests that Green strategy should be developed by engaging stakeholders (Murugesan and Molla, 2011:46). However, some of the participants felt that their companies were not involving them and are participating only to a certain extent. This implies that the lack of employee participation in Green IT implementation will have limited success.

Knowledge of IT personnel to implement Green IT: This was described by the participants as an important factor in Green IT implementation. According to the participants, knowledge of Green IT is vital in ensuring the success of the Green IT programme. Therefore, they felt that their IT personnel have capacity to adapt to new technologies. On the contrary, some of the participants viewed their companies having limited knowledge on Green IT. They felt that their IT personnel do not possess the necessary skills and knowledge to ensure successful Green IT implementation. According to the participants, this is inhibiting the success of Green IT implementation. This implies that the lack of knowledge of IT personnel is likely to limit the proper implementation of Green IT.

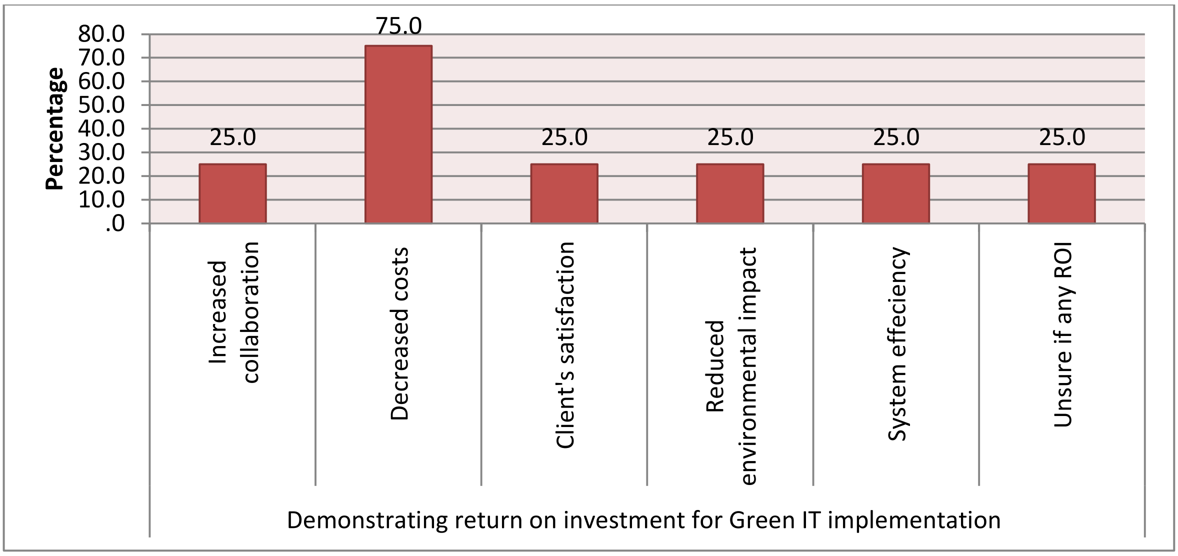

Figure 4.23 Demonstrating return on investment for Green IT implementation

Figure 4.23 illustrates the demonstration of return on investment for Green IT implementation as follows:

Increased collaboration: This was mentioned by participants as an element that demonstrates return on investment for Green IT implementation and business value. The participants felt that renewal energy can provide competitive returns for their companies in some of the business markets. As indicated by Devarajan et al. (2009:107), Green IT implementation is an investment for organisations and will result in competitive returns through increased collaboration.

Decreased costs: This was viewed by the participants as the main driver that demonstrates return on investment for their companies. According to the participants, decreasing the costs of doing business can lead to substantial savings for the companies and it can improve energy efficiency that will lead to reduction in pollution. This is in agreement with literature that the reduction of pollution and improving energy efficiency will in turn decrease the cost for organisations (Talebi and Way, 2009).

Client satisfaction: This was mentioned by participants as another factor that demonstrates return on investment for Green IT implementation for their companies. The participants felt that fulfilling their customer expectations yields positive results for their business. This is in agreement with the previous findings in the literature, that there is an increase in the demand of ecological products because the customers are aware of environmental issues and the need to protect the environment (Smith and Perks, 2010:3). In Green IT context, going green can be an attractive goal to gain goodwill and consumer support (Hannel, 2014).

Reduced environmental impact: This was described by participants as a primary factor that demonstrates return on investment. The protection of the environment is identified by participants as a key factor in improving business performance for their companies. This confirms previous findings in the literature that organisations has begun to have a sense of environmental protection because of the growing ecological crisis (Shuanggui, Jing and Shiyuan, 2011:253). This suggests that the protection of the environment can benefit the society and businesses.

System efficiency: This was named by the participants as a contributor to demonstrate return on investment. This helps the organisation to seek alternative clean resources to improve their efficiency by designing technologies that are less harmful to the environment. The participants felt that their companies can reap some benefits through system efficiency. In view of literature, organisations are minimizing environmental footprint and energy consumption through the design and use of advanced and clean technologies (Molla, 2009). This suggests that an effecient system plays an important role in Green IT implementation.

Uncertainty of any return on investment: This was highlighted by participants as a factor that delimits the demonstration of return on investment for Green IT implementation. This is a surprising finding considering the important role that Green IT is playing in saving money for the organisations and protecting the environment. Investment in Green IT has the potential to increase the bottom lines of the organisations (Devarajan et al., 2009:107).

Table 4.2 Vendor management incorporation to Green IT strategy

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	2	25.0	25.0	25.0
	No	4	50.0	50.0	75.0
	Unsure	2	25.0	25.0	100.0
	Total	8	100.0	100.0	

Table 4.2 displays the vendor management of the organisations being incorporated to Green IT strategy.

Vendor management fitting into business strategy: This was described by participants as a factor that will lead to competitive advantage for their business. This will help the companies to develop strategic plans that are based on long term objectives leading to financial benefits and environmental sustainability. This lends support to previous findings in literature that there is a real, economic imperative to change and improve organisations environmental credentials. The underlying reason is that the investors are beginning to demand more disclosures from companies with regard to their carbon footprint, as well as their environmental initiatives and achievements (Lake, 2014). In this regard, manufacturers are improving their processes at all the life stages to minimise harm by employing cleaner technologies. Furthermore, they also provide environmental information that organisations can use to make buying choices (Gartner, 2007). On the contrary, some of the participants were uncertain about their vendor system fitting into the business Green IT strategy. According to the participants, this is an element of deficiency in managing the vendor. As suggested by Smith and Perks (2010:3), organisations should have green visions and strategic plans that are based on long term objectives for environmental sustainability. This implies that the Green IT strategy should be aligned with the business strategy to enhance organizational competitiveness and managing environmental aspects (Erek, 2011:2).

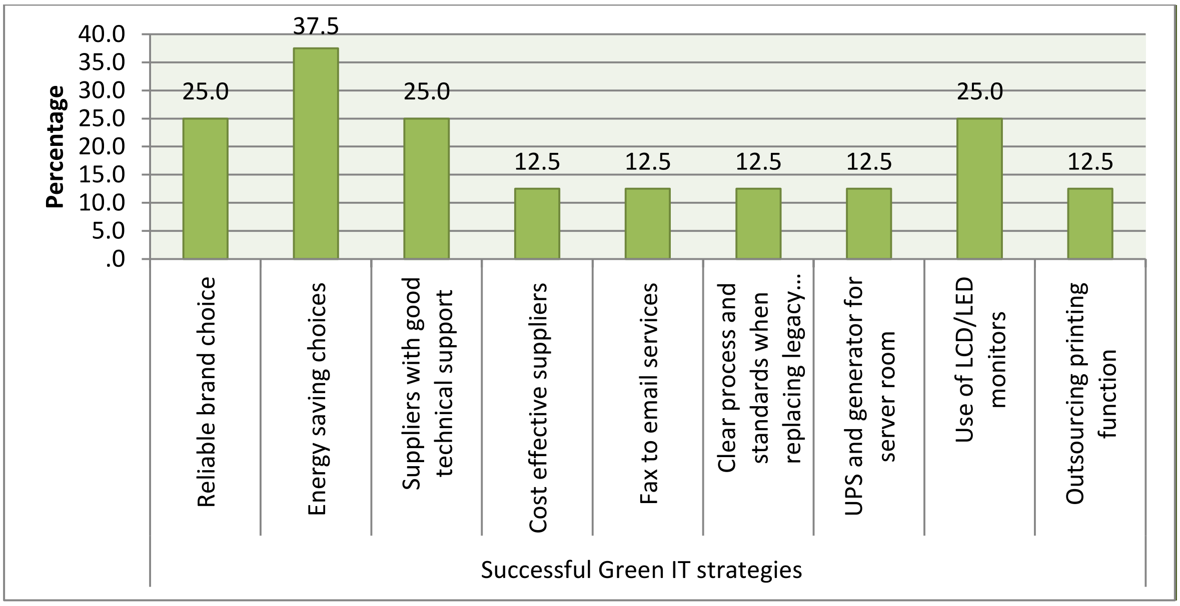

Figure 4.24 Successful Green IT strategies

Figure 4.24 demonstrates the successful Green IT strategies and described briefly as follows:

Reliable brand choice: This was mentioned by participants as a factor contributing to the successful implementation of Green IT. In view of this finding, organisations are redesigning strategies to strengthen their brand through showcasing their initiatives and providing business opportunities (Hedman and Henningsson, 2011:56).

Energy saving choices: This was identified by participants as one of the elements preferred by their organisations for successful Green IT implementation. Research studies support this finding, that IT is regarded as the driver for energy saving and innovation (Harmon and Auseklis, 2009:1701-1712). This suggests that energy saving choices is playing a significant role in the success of Green IT implementation (Murugesan, 2011:46).

Supplier with good technical support: This was named by participants as a specific element that their companies viewed as a successful factor for Green IT implementation. According to the participants, good technical support is beneficial for their companies for efficiency and effectiveness of their business operation. This is in agreement with previous research findings in literature that technical support and capacity is necessary to ensure efficiency of the business operation (Khurrum et al., 2011:2). In this regard, Green IT is regarded as a social and technical arena for innovation (Rahim and Rahman, 2013:80).

Cost effective suppliers: This was viewed by the participants as an important factor for successful Green IT strategy. As reported by Uddin and Rahman (2012:4078-4079), organisations are moving towards Green IT implementation to make their business cost effective and sustainable. This suggests that the selection of a cost effective supplier is beneficial for the succesful implementation of Green IT.

Fax to email services: This was identified as a contributory factor for the successful implementation of Green IT. The participants viewed fax to email services as producing fruits for their companies. This finding suggests that excess copiers and fax machines should be eliminated where possible. The organisations should set fax machines so that faxes are received electronically rather than in hard copy form. Previous studies indicates that the high hopes rest upon Green IT implementation to reduce energy consumption and contribute to energy savings because it is an enabling tool for energy efficiency (Mattern, Staake and Weiss, 2010).

Replacing legacy equipment: According to participants, clear processes and standards are required when replacing legacy equipment. They felt that this is beneficial for the successful implementation of Green IT for their companies. It is acknowledged by studies that IT is contributing to environmental problems because of the increased number of computers and their frequent replacement (Uddin and Rahman, 2012:4081). This implies putting measures and clear processes in place to replace legacy equipment with new computers.

UPS and generator for server room: This was mentioned by the participants as an advantage for their company for successful Green IT strategy. This is in agreement with previous findings in the literature that backup power supplies such as UPS and generators are essential for computer systems and associated components for communication connections and security (Hogan, 2011:20). This suggests that the UPS and generator for server rooms play a meaningful role in the success of Green IT implementation.

LCD/LED monitors: This was viewed by the participants as contributing enormously to energy savings and contribution to their Green IT strategy. This is consistent with previous findings in the literature, that liquid crystal display (LCD) and light-emitting diode (LED) monitors and other energy efficient technology require less energy to perform their function (Uddin and Rahman, 2012:4083). It is acknowledged by literature that the new generations of products such as computers, screens and mobile infrastructure equipment have led to an average 30% power consumption efficiency gain in past years through environmentally friendly design and development (Editor, 2009:8). This suggests that LCD/LED monitors can lead to substantial operational cost saving by reducing energy bills.

Outsourcing printing function: This was mentioned by the participants as another contributor to the success of Green IT strategy. This finding proposes that the printing function should be provided by an external service provider. There is strong evidence that suggests that IT equipments such as printing have potential impact to the environment because of its increased energy consumption (Childs, 2008). Some of the participants did not provide answers to this question. This can be attributed to lack of knowledge in Green IT implementation.

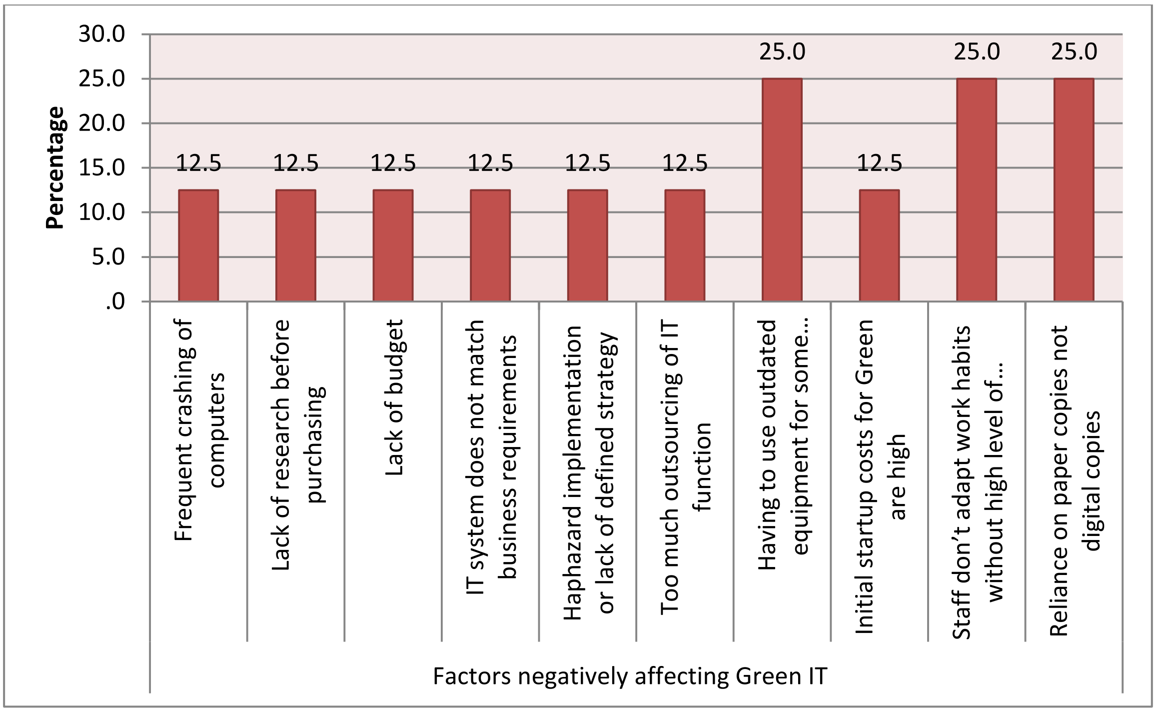

Figure 4.25 Factors that negatively affect Green IT implementation

Figure 4.25 shows the factors that are negatively affecting Green IT and described below:

Frequent crashing of computers: This was described by participants as a negative factor that impedes the Green IT implementation. The participants felt that the crashing of computers contributes significantly to operational costs and lead to failure of Green IT strategy. This confirms the findings of previous literature that obsolete and discarded IT products are exported to developing countries for repairs and reuse (Osibanjo and Nnorom, 2007:492). This suggests that this exported IT products are posing a challenge of computer crashing resulting in increased business costs and decline in performance.

Lack of research before purchasing: This was specified by participants as a contributory factor to the failure of Green IT implementation. The participants felt that conducting research before purchasing is critical towards successful Green IT strategy. This lends support to previous findings in the literature that little research is conducted before purchasing IT products and it is impacting on the Green IT strategy (Green and McCann, 2011:446-461). This suggests that the organisations are failing to recognise the importance of research before conducting their purchases.

Lack of IT budget: According to the participants, limited IT budget spent on company technology inhibits the effectiveness of Green IT strategy. They felt that IT operations are not adequately supported in finances. This is in agreement with the previous studies, that Green IT implementation suffers drawbacks because of lack of financial management resources (Waema, 2013:100). It is acknowledged by previous studies that energy costs on IT equipments are eroding IT spending (Tallon and Scannell, 2007:65). This implies that the lack of IT budget is a major challenge for IT managers (Harmon and Auseklis, 2009:1708).

IT system does not match business requirements: It was mentioned by participants that without any doubt IT system that does not match business requirements results in failure of the Green IT strategy. The participants felt that their IT system should match their business requirements. This is a suprising finding considering that the business strategy and goals must be clearly defined by a Green IT strategy to realise business goals (Uddin and Rahman, 2012:4079-4080). This suggests limited knowledge of Green IT implementation.

Haphazard implementation or lack of defined strategy: The participants viewed uncoordinated implementation and lack of defined strategy for Green IT impeding the success of its implementation. The participants felt that their companies do not possess the necessary knowledge to implement the Green IT strategy. It is acknowledged by Hodges, (2004), that the lack of business strategy will fail to identify opportunities for greater efficiency that can be benefited from new technology, and may cause difficulty for organisations to achieve Green IT value. In this regard, many organisations are approaching the management of IT in an unstructured manner through its life cycle (Steward, ND). This suggests that haphazard implementation or lack of defined strategy neglects the benefits of Green IT implementation.

Too much outsourcing of IT function: According to the participants this is the primary factor that hampers the implementation of Green IT strategy. They felt that outsourcing poses a serious challenge for their business because they don’t have proper control. This implies that the organisations are exposed to possibility of weak management, inexperienced staff, business uncertainty, outdated technology skills, hidden costs, lack of organisational learning and loss of innovative capacity.

Using outdated equipment for some applications: This was described by participants as a factor that is posing a challenge for the success of their company’s Green IT strategy. The participants felt that their companies should use current and relevant pieces of equipment for some of their applications. This suggest that the organisations are running the risk of computer crashes and system down time, decreased productivity, increased costs, security vulnerability and non-compliance with applicable legislation, policies and regulations. The computer software update can help optimise IT operations.

Initial start-up cost for Green being high: This was viewed by participants as a factor that is impeding the Green IT strategy because it is not affordable. The participants felt that their companies do not embrace green because it is not affordable. This is in agreement with previous findings in the literature that the technology associated with green living is often at a much higher cost (Lake, 2014). Going green can be an attractive goal to gain goodwill and customer support (Hannel, 2014). This suggests that the cost of Green IT implementation inhibits the organisations to adopt the Green IT practice.

Staff not adapting to their work habits without supervision: This was described by participants as an element that is causing the collapse of their Green IT strategy. The participants felt that their staff are inadequately trained. This suggests that staff attitude is likely to hamper Green IT implementation.

Reliance on paper copies not digital copies: This was mentioned by participants as another factor that hinders their success of going green. According to the participants, going digital has enormous benefits for their companies. This concurs with previous finding in the literature that reliance on paper rather than digital copies contributes to the evil beast called carbon (Campbell, Ratcliffe and Moore, 2013:127). This is despite technology having the potential to save the planet if it is used properly (Roosa and Jhaveri, 2009). This implies that reliance on paper copies is posing challenges to sustainability of the digital economy (Uddin and Rahman, 2012:4078-4082).

Cost of repairs being expensive: According to the participants, the cost of repairs is expensive because local brands are less durable, and they rely on desktop PC's. The participants felt that this is contributing to their failure in the Green IT implementation. This is consistent with the past findings in the literature that the IT sector is posing a threat to sustainable development because of the inevitable amount of obsolete, discarded, and broken or abandoned IT products (Osibanjo and Nnorom, 2007:492). This finding suggests that the cost of repairs for obsolete and discarded IT products is expensive. Therefore, the cost of repairing these IT products is not a feasible option.

4.5 ASSOCIATIVE STATISTICS - CORRESPONDENCE ANALYSIS

Correspondence analysis (CA) is a statistical technique that provides a graphic representation of cross tabulations. The cross tabulations arise whenever it is possible to place events into two or more different sets of categories. Essentially, correspondence analysis (CA) is a descriptive, exploratory technique that allows defining the nature and structure of the relationship between qualitative variables measured in nominal and ordinal scales (Stanisz, 2007). Typically, it therefore allows the researchers to understand the relationship between the levels of variables. It is conducted by constructing cross tabulations between variables and plotting correspondence plots, relationships between levels of variables or lack of relationship that can be easily noticed. Intrinsically, variables that are close to each other are said to be related and those that are far apart are not related. Accordingly, CA can reveal relationships that would not be identified using other non-multivariate statistical technique such as performing pairwise comparison. It can present data using two dual displays, one display for the row data and another for display on the column data. As a result, this makes analysis of data more easily compared to other statistical techniques that do not provide dual display. More importantly, some of the benefit for CA is that it can simplify complex data from potentially large table into a simpler display or categorical variables while preserving all the valuable information in the data. Therefore, it makes it easy to add supplementary data points that may assist in the interpretation of the model into the analysis post hoc. It is one of the valuable statistical techniques in part because it can be used by researchers and professionals who analyse categorical variables. It has the potential to analyse the research questions across many domains (Doey and Kurta, 2011:6-7).

Research studies indicate that correspondence analysis can simplify complex data from potentially large table into a simpler display of categorical variable while preserving all of the valuable information in the data set. Accordingly, this is valuable when it would be appropriate to use a table to display the data because the data associations between variables would not be apparent due to the size of the table. It is important to note that most other exploratory statistical techniques do not provide plot associations among variables. Thus correspondence analysis can reveal relationships that would not be identified using other non-multivariate statistical techniques such as performing pairing comparisons. It is also a good way to examine the data validity as it facilitates the treatment of outliers (Fellenberg et al., 2001).

4.5.1 Correspondence analysis for question 2.1 and 4.3

It is clearly evident in Figure 4.26 that cost savings/reduction in cost and environmental benefits are closely associated with the supplier being responsible for disposal. Therefore, the organisations which are falling to this area of the quadrant could be described as having moral values to preserve the environment and ensuring that they reduce on business costs by ensuring that the supplier is responsible for their IT disposal.

Furthermore, it can be noted that the theme, human health benefit, is closely associated with the use of an outsourced recycling company, taking back to the supplier and refurbishing or reselling. These two groupings are on opposite quadrants of the plot and so they are opposing each other. Moreover, the theme, try to repair / upgrade before scrapping, is in the same direction with the first grouping. As a result, the organisations falling within the opposite quadrants of the plot could be described as taking human health into cognisance by ensuring that they use an outside company, take back items to the supplier and increasing the life span of their IT equipments. Therefore, it is important to note that pieces of IT equipment contain hazardous materials that can be detrimental to human health.

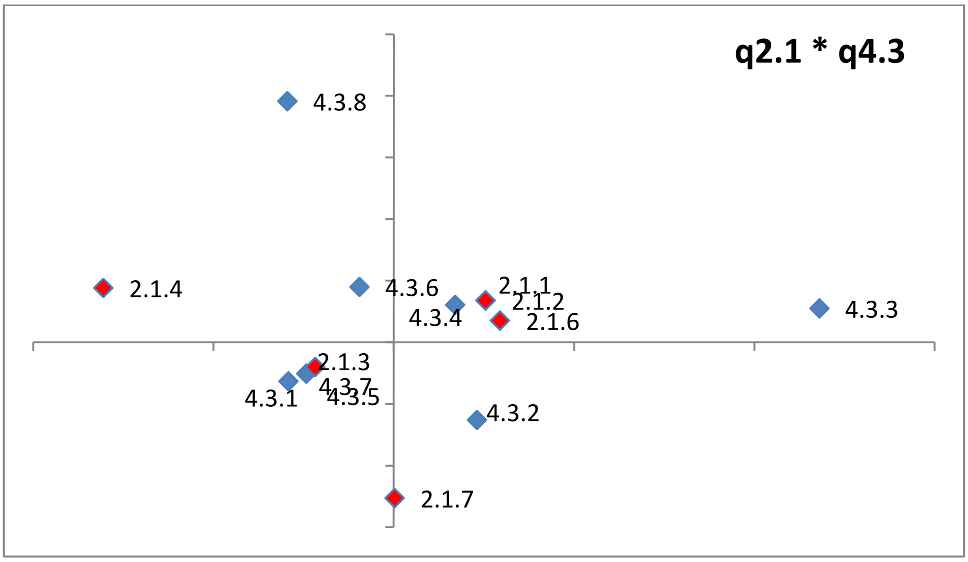

Figure 4.26 Correspondence Plot for Q2.1 * q4.3

4.5.2 Correspondence analysis for question 2.1 and 3.6

It was discovered in Figure 4.27 that the theme green is closely associated with human health; money is associated with sustainable future and both green and money are associated with cost and environmental benefits. Therefore, this means that the companies that fall close to this area of the plot can be described as adopting Green IT for financial gain and contributing to sustainable future.

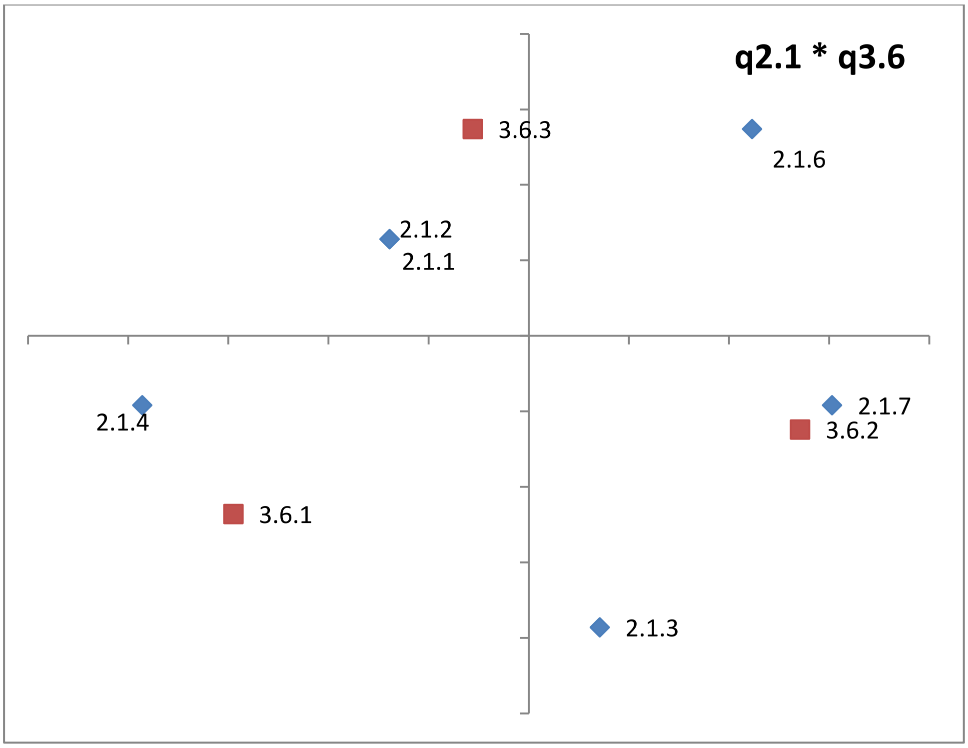

Figure 4.27 Correspondence Plot Q2.1 * q3.6

4.5.3 Correspondence analysis for Question 2.4 and 3.4

As illustrated in Figure 4.28, using IM communication to reduce travel and ensuring safe disposal of old equipment is associated with cost saving and quality and reliability (upper left quadrant). This means that the industries falling with the upper left quadrant could be described as having utilising advanced technologies to reduce on travelling and ensuring that they dispose of their pieces of IT equipment safely to reduce the cost of doing business by using quality and reliable brands.

Moreover, the theme manually switching off the computer daily and not believing that IT department causes environmental harm are associated with task specific requirements on the upper right quadrant. This means the companies falling in this quadrant can be described as buying computers according to business requirements and taking into consideration the cost of energy consumption of computers because it has the potential to cause environmental damage.

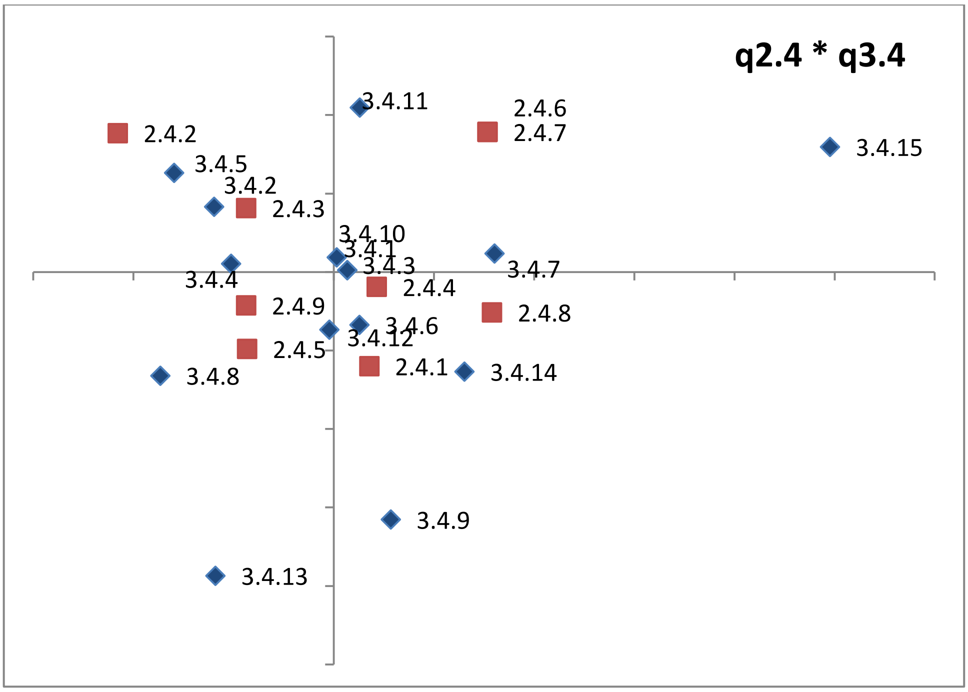

Figure 4.28 Correspondence Plot Q2.4 * q3.4

4.5.4 Correspondence analysis for question 4.6 and 3.5

The display in Figure 4.29 shows that the right top and bottom level quadrants have two groupings. The theme, regularly repairing hardware to increase life span and use parts from broken computers, is associated with no steps being taken to change the status quo and minimising unnecessary hardware. Therefore, the company falling within this quadrant can be described as repairing their computers to minimise unnecessary hardware and prolonging their life span.

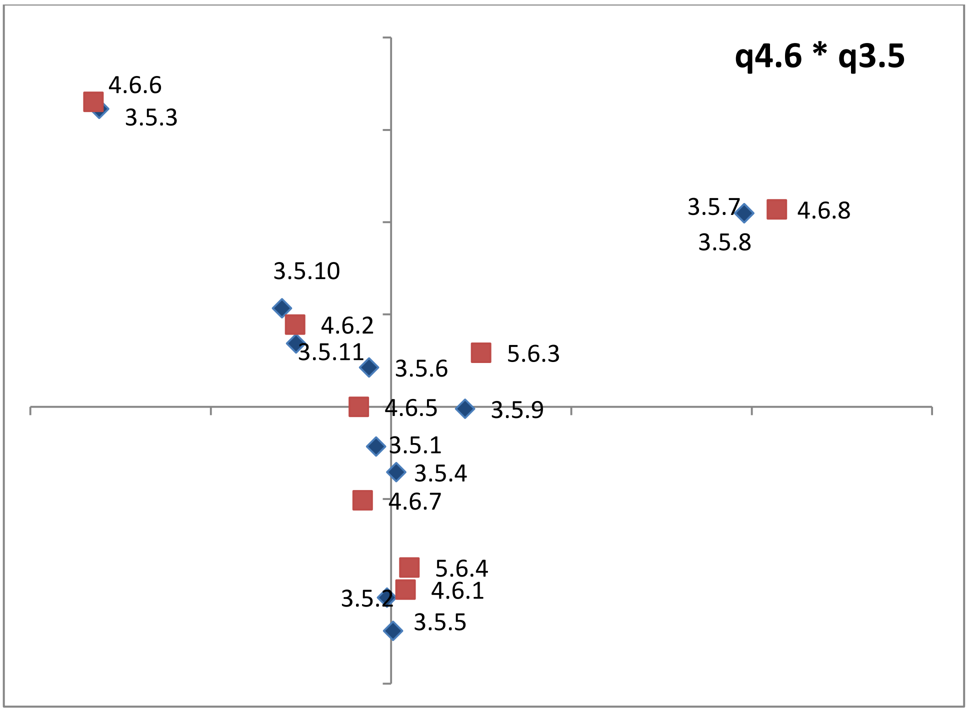

Figure 4.29 Correspondence Plot q 4.6 * q 3.5

4.5.5 Correspondence analysis for question 4.2 and 4.6

As illustrated in Figure 4.30, IT does not consider the product life cycle and recycling issues upfront when buying computers and peripherals, is associated with only occasional repair to increase life span outside warranty. The companies falling in this quadrant can be described as conducting repairs on their computers and do not consider warranty.

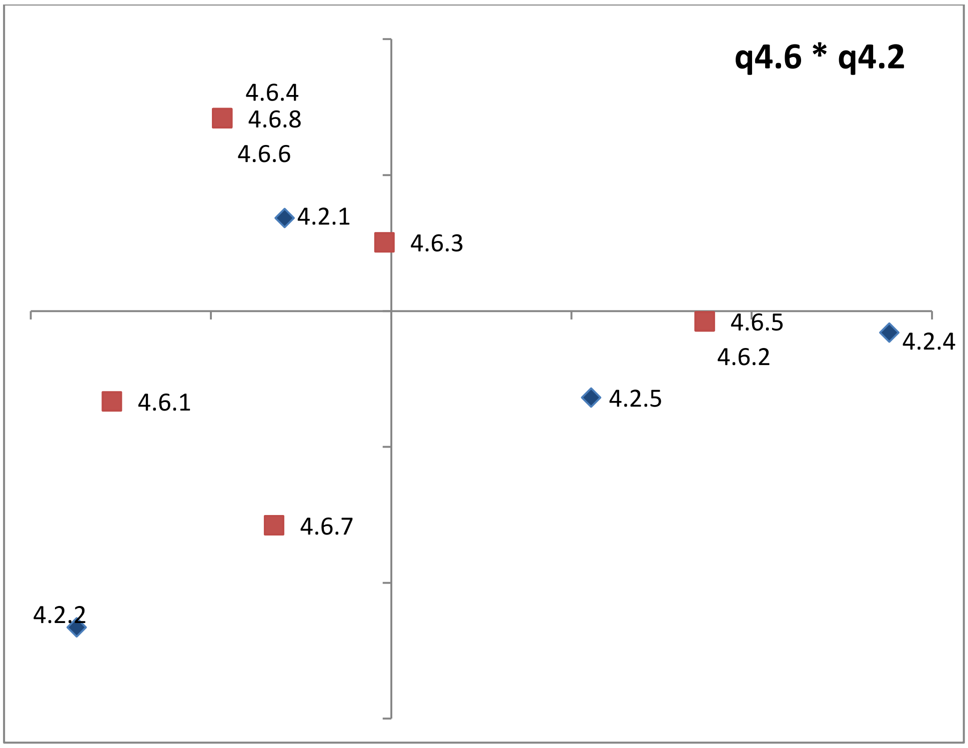

Figure 4.30 Correspondence Plot Q 4.2 * q 4.6

Figure 4.30 also shows that the themes, do not try to increase life span beyond warranty and do not repair, are associated with "Yes" as a factor that influences the buying process. The companies falling close to this area of the plot could be described as utilising recent technology because they buy frequently and don't increase the life span beyond warranty.

Furthermore, the themes regularly repair to increase life span and buy parts, are associated with "probably yes" as a factor that influences the buying process. The companies falling in this quadrant could be described as utilising computers for longer periods by utilising repairs.

Moreover, upgrade software's and licence renewal are associated with "No" on factors that influence the buying process. The companies that fall in this quadrant are not influenced by licences and software upgrades in their buying process.

4.5.6 Correspondence analysis for question 4.3 and 5.3

As demonstrated in Figure 4.31, the theme, try to repair/upgrade before scrapping, is associated with using recycled or refurbished parts to repair machines. The companies falling within this quadrant could be described as prolonging the life span of their pieces of IT equipment through recycling and repairs.

Furthermore, taking pieces of equipment back to the supplier is associated with compliance with all policies and procedures. The companies which fall to this area of the quadrant could be described as managing their e-waste effectively.

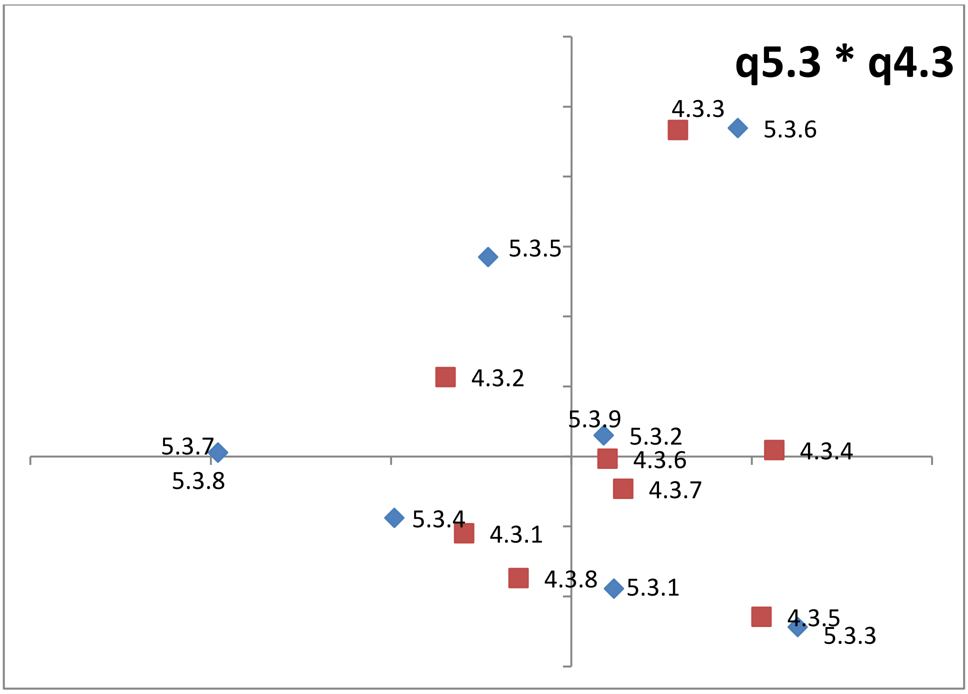

Figure 4.31 Correspondence Plot Q 4.3 * q 5.3

4.5.7 Correspondence analysis for question 4.4 and 5.4

As displayed in Figure 4.32 the theme ISO 14001 and training/educating staff, is associated with, sold as scraps and no recycling company is being used. The organisations which fall in this quadrant could be described as having effective management system to deal with their e-waste.

The theme, no need for systems as IT doesn't cause environmental harm, is associated with obsolete equipment being returned to the supplier or traded. The companies falling in this quadrant could be described as utilising effective means to manage or control their e-waste.

The theme, conforms to relevant environmental policies and auditing energy consumption, is associated with external company responsible for disposal and all components being separated first. The organisations which fall close to this plot could be described as having effective measures in place to control their e-waste.

The theme ISO 9001 is associated with batteries of laptops being collected by external company and does not have obsolete computers. The companies falling in this quadrant could be described as having effective means to manage their e-waste.

The theme, not sure of systems/no system and train/educate staff is associated with, try to repair/upgrade before scrapping, supplier responsible for disposal and refurbish/resell. The companies which fall in this quadrant could be described as utilising uncoordinated efforts to manage their e-waste.

The themes, conform to relevant environmental policies and audit energy consumption, are associated with strongly agree on factors influencing purchasing of IT devices and all components being separated first. The companies which fall in this quadrant could be described as ensuring that their pieces of IT equipment are meeting the environmental standards and are energy efficient.

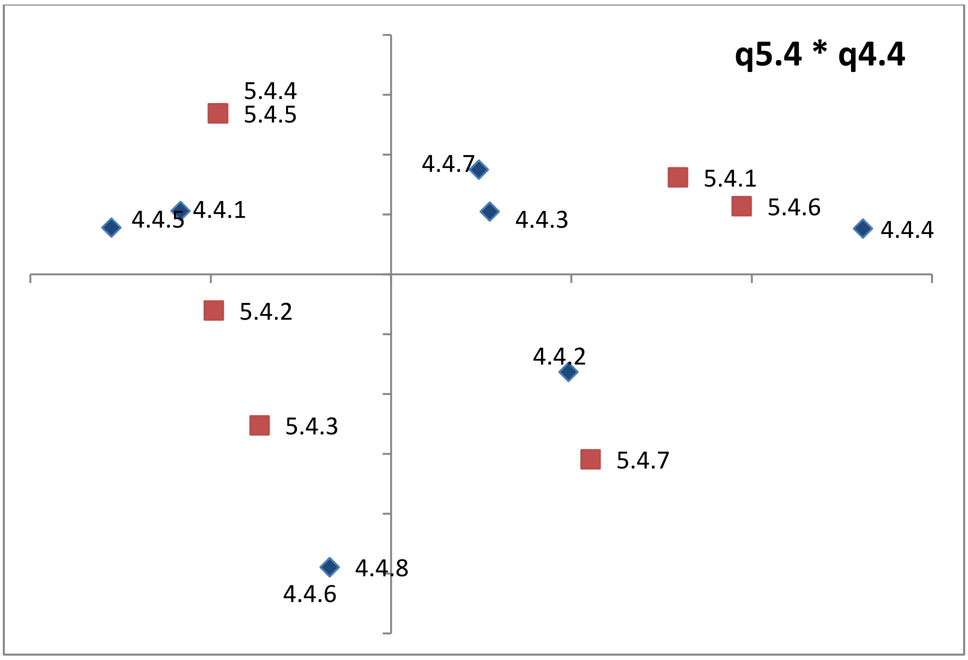

Figure 4.32 Correspondence Plot for Q 5.4 * q 4.4

4.5.8 Correspondence analysis for question 5.2 and 5.1

As illustrated in Figure 5.33 the themes neutral/unsure on legislataions/regulations that adress environmental issues are associated with disgreement that there are business policies/regulations in place to adress harmful impact caused by IT use. The companies which fall in this quadrant could be uncertain about legislations that adress environmental aspects.

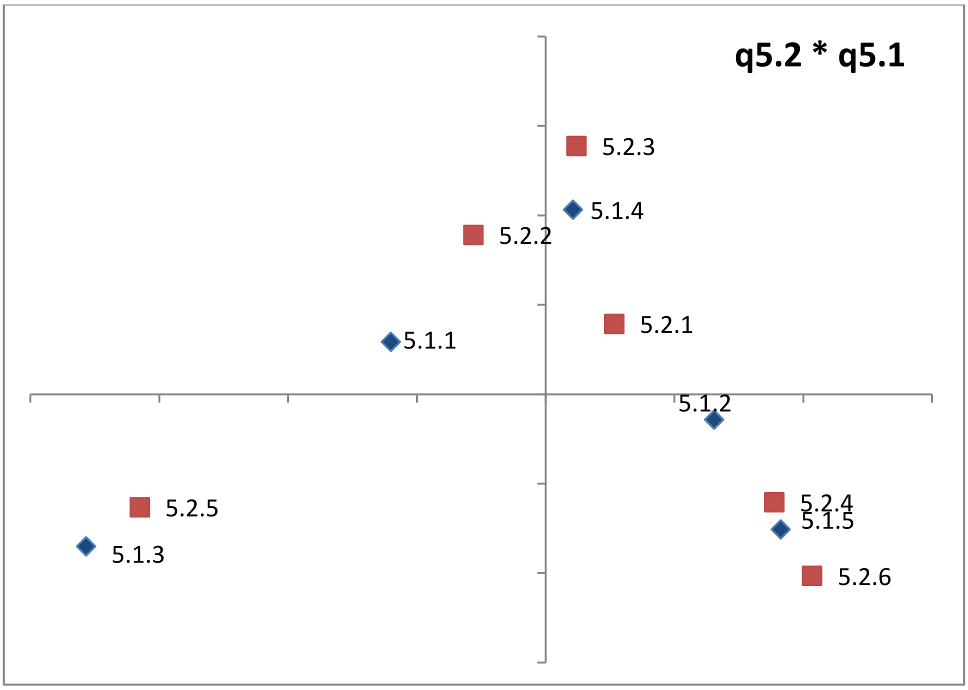

Figure 4.33 Correspondence Plot Q5.2 * q5.1

4.5.9 Correspondence analysis for question 6.2 and 2.1

As displayed in Figure 4.34 the theme, human health benefits and sustainable future, is associated green plugs. The companies which fall in this quadrant could be described as utilising green products to prevent adverse health effect and ensuring environmental sustainability.

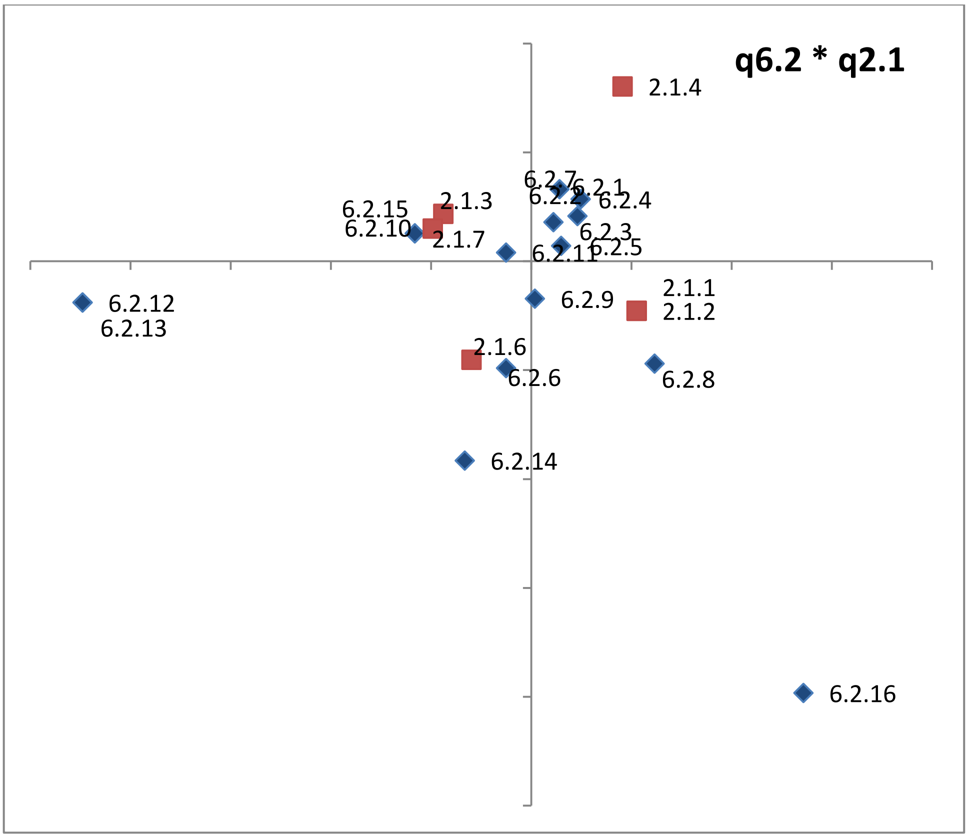

Figure 4.34 Correspondence Plot Q 6.2 * q 2.1

4.5.10 Correspondence analysis for question 6.3 and 2.1

In Figure 4.35 the theme, cost reduction, is associated with corporate social responsibility requirements being fulfilled. The companies which fall to this quadrant could be described as reducing the cost and meeting the corporate social responsibility obligation.

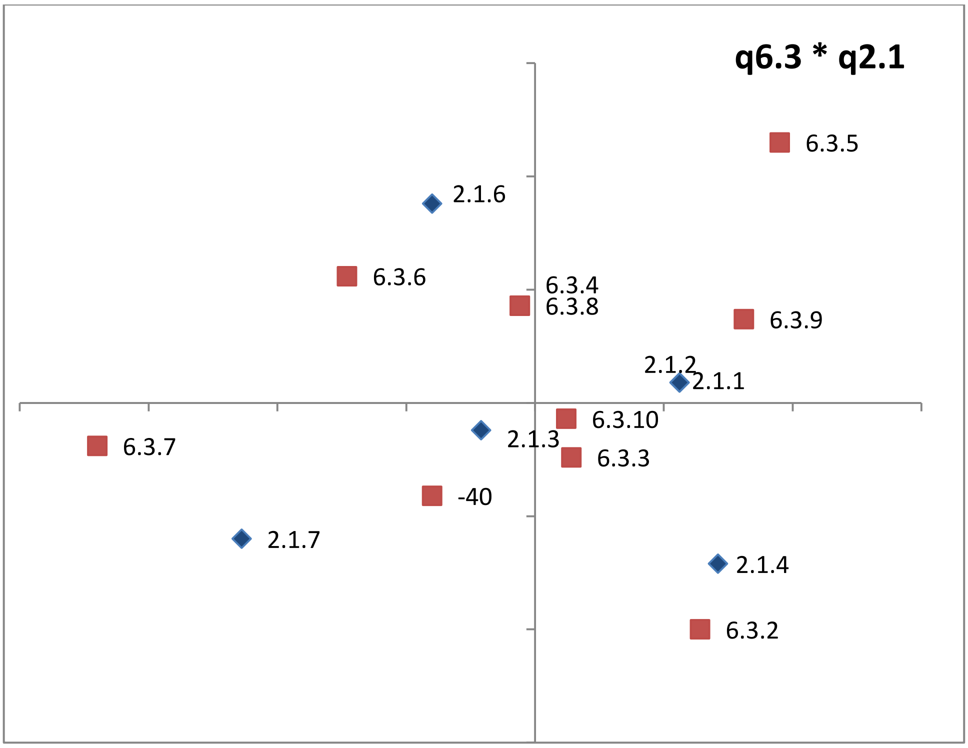

Figure 4.35 Correspondence Plot Q 6.3 * q 2.1

4.5.11 Correspondence analysis for question 6.4 and 3.3

In Figure 4.36, purchase computers as needed, is associated with unsure if the company analysed energy cost implications to promote energy efficiency. The companies falling to this quadrant could be described as not determining their energy consumption.

IT manager makes decisions on purchases and aims to increase the IT equipment life span, reuse IT equipment as far as possible, automatically replacing every 3 years, are associated with analysed energy cost implications to promote energy efficiency . The companies falling to this quadrant could be described as having appropriate systems in place to reduce their energy costs, proper procurement and prolonging their IT equipment's life span.

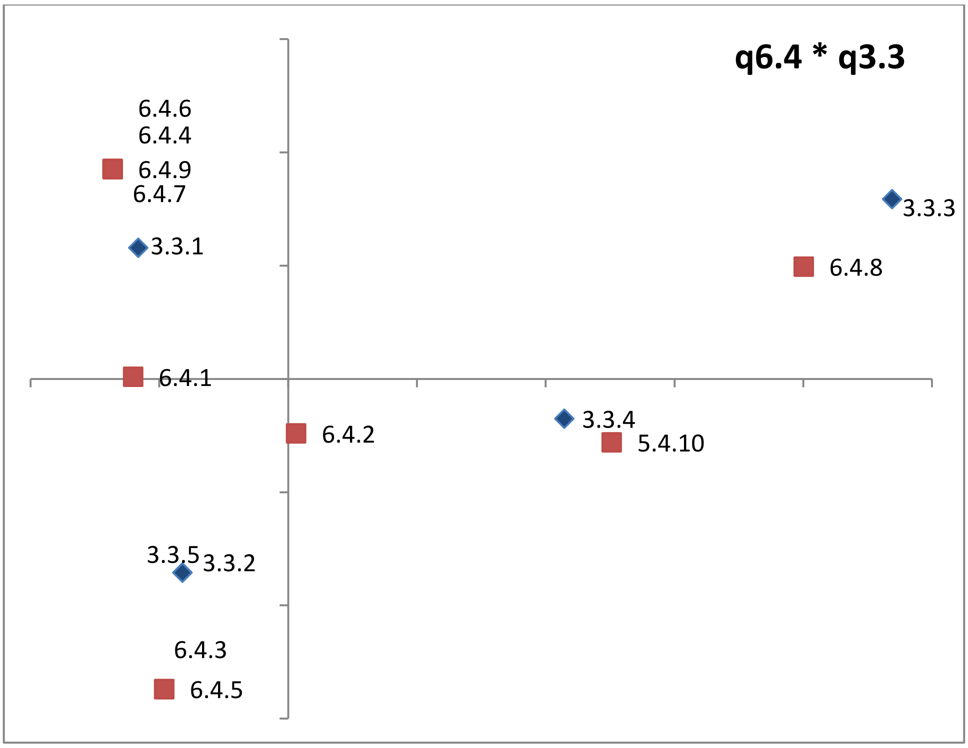

Figure 4.36 Correspondence Plot Q 6.4 * q 3.3

4.5.12 Correspondence analysis for question 6.8 and 6.1

As demonstrated in Figure 4.37, green IT being an investment for the company, is related to decreased costs, client satisfaction and system efficiency. The companies falling to this quadrant could be described as adopting Green IT to reduce the business cost.

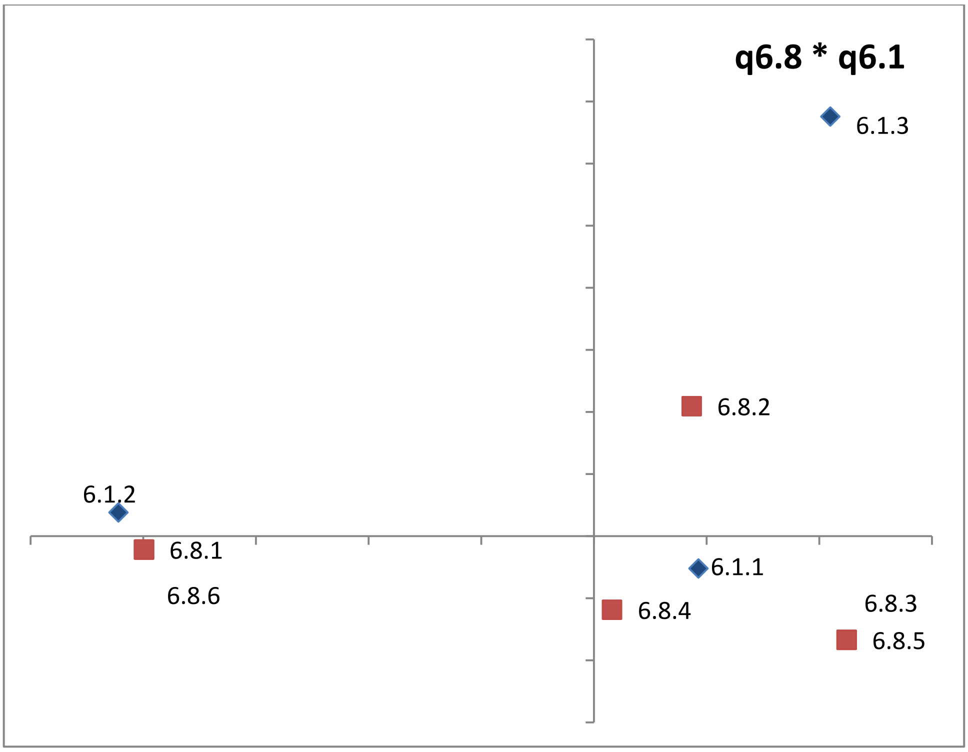

Figure 4.37 Correspondence Plot Q 6.8 * q 6.1

4.6 CHAPTER SUMMARY AND CONCLUSION

From the analysis of the interviews, a number of issues emerged with regard to factors that inhibit the Green IT implementation. The interview revealed that ecological issues, lack of training on policies and regulations, unstructured and uncoordinated green IT implementation, limited knowledge to green data centres, too much outsourcing, incapacity to recycle, improper e-waste disposal, lack of e-waste legislations, limited knowledge of IT personnel, inadequate involvement of employees and poor vendor management, are hampering the implementation of Green IT.

In this chapter, research findings have been presented and analysed. There has been coordination with the primary data. It is very interesting to note some of the literature review has been confirmed by the responses from the interview tool. The findings highlighted some of the issues relating to Green IT implementation that have caused a debate across the industry. Overwhelmingly, the findings have also established a link between the literature which was reviewed in this study with the data which was collected and presented. This was based on the findings from the research interviews conducted from eight South African companies. In the research interviews, certain questions were asked and analysis was done using the SPSS statistical package, Chi-square and Correspondence analysis. The study utilised a qualitative approach to describe and analyse the Green IT phenomena with the aim of developing a framework. This was followed by detailing the findings and associative statistics.

The next chapter consolidates the findings of the research derived from analysis and interpretation of statistical data. The chapter comprises the summary of the study and addresses the findings per research questions.

CHAPTER 5: DATA INTERPRETATION

5.1 INTRODUCTION

The impact of Green IT implementation in creating a sustainable environment is presently unknown. The purpose of this study was to develop a framework for Green information technology implementation in South African organisations. The study provides an outline of technology optimisation to address ecological issues, energy efficiency and alternative technologies, e-waste management, legislation and regulations to address environmental issues and Green IT framework.

This chapter consolidates the findings of the research derived from analysis and interpretation of statistical data discussed in the previous section. The research questions pertaining to method of technology that can be used to reduce pollution and contribute to optimal use of renewal energy, methods that can be used to reduce energy consumption as a result of green technology, the approach that can be used in the design, production, operation and disposal of IT products in a manner that is not harmful to the environment, the strategies that can be used to help IT contribute to environmental solutions and the sources that can be used to determine the impact of adoption of strategic Green IT towards creating a sustainable environment are answered.

This chapter comprises a summary of the study, and the findings per research question. Conclusion of the study is drawn to create the Green IT framework.

5.2 SUMMARY OF THE STUDY

The main findings of this research in relation to each research question are discussed and each question is followed by a discussion of the findings relating to that question. The impact of Green IT implementation in creating a sustainable environment is presently unknown. The aim of this study was to demonstrate that the results of Green IT, if not adopted leads to rising cost of energy, depletion of natural resources and increase in concern for the environment by the general population. The objectives were to determine the impact of IT related products on the environment and health, describe the development and implementation of Green IT into business strategic plans, critically evaluate the approach to Green IT, determine measures that can be used by organisations to implement Green IT and create a sustainable environment and develop a framework for Green IT implementation. The study revealed the method of technology that can be used to reduce pollution and contribute to optimal use of renewal energy, methods that can be used to reduce energy consumption, the approach that can be used in the design, production, operation and disposal of IT products, the strategies that can be used to help IT contribute to environmental solutions and the sources that can be used to determine the impact of the adoption of strategic Green IT towards creating a sustainable environment.

5.3 RESPONSE TO RESEARCH QUESTIONS

The main findings of this research in relation to each research question are discussed below. Each question is followed by a discussion of the findings relating to that question.

5.3.1 What methods of technology can be used to reduce pollution and contribute to the optimal use of renewable energy?

The result of the study found in Figure 4.5 that the participants shared different views on different methods of technology used in their companies to minimise sensitive materials of IT products that impact the environment. The participants viewed the following methods of technology as beneficial for their companies in order to reduce pollution and contribute to the optimal renewal energy.

Green products purchase: The participants viewed purchasing green products that are environmentally friendly as essential for their companies in minimising the harmful environmental impact. In relation to green product purchase, the selection of green products involves making trade-offs between environmental impact. As stated by participants, the purchasing of green products is beneficial for their companies in reducing harm to the environment and providing a sense of environmental awareness. On the contrary, in Figure 4.7 the participants indicated that their purchase is not focusing on green or energy savings. According to the participants, they buy without considering the green aspects. Overall, purchasing green products is one of the important drivers cited by participants as a method of technology to reduce pollution and contribute to the optimal use of renewal energy.

IM communication: The participants in Figure 4.5 mentioned that they are utilising IM communication in order to reduce travelling because it contributes to environmental damage through carbon emission. It is acknowledged by participants that investing in IM communication has potential benefits for their companies in reducing environmental harm. In view of IM communication, it was also found in Figure 4.25 that using IM communication to reduce travel is associated with cost saving. This could mean that the companies are utilising advanced technologies to reduce travelling costs.

Bio plugs: This was described by the participants in Figure 4.5 as a method of technology utilised by their companies to reduce or minimise the impact of sensitive materials. This type of technology supports energy efficiency and helps in reducing the impact that is caused by IT products/equipment. This could be interpreted to mean that the organisations are investing in energy efficient technologies to contribute to optimal renewal energy while at the same time reducing pollution.

Safe disposal: According to participants in Figure 4.5, safe disposal of old equipment is an important factor in minimising environmental degradation resulting from improper disposal of obsolete IT equipment. In view of this concern, the participants felt that effective and efficient procedures to manage e-Waste should be developed and implemented. However, in Figure 4.11 the participants mentioned that they have limited knowledge of the disposal of obsolete electronic pieces of equipment. As a result, e-waste is posing a challenge for their organisations. It is believed by the author that disposal of e-waste is not properly managed.

Printing reduction: This was viewed by the participants in Figure 4.5 as a contributing factor to escalating business costs and thus contributing to high energy consumption. Given the implication of the high level of printing, the participants were of the view that reduction in printing will minimise environmental harm and will contribute significantly to the business profit margins. In line with this finding, the reduction of printing was therefore deemed to be an important driver in minimising pollution and contributing to optimal use of renewable energy.

Use of UPS and generator: This was described by the participants in Figure 4.5 as a measure to provide emergency power to a load when the input power source/main fails. In Green IT context, the participants indicated that their companies should find alternative clean resources to improve energy efficiency through the design and use of advanced technology to achieve environmental sustainability. They also viewed the use of UPS and generators as preventing possible power interruptions. In general, the use of UPS and generators contributes significantly in optimising renewal energy.

Manually switching off computers: This was described by participants in Figure 4.5 as a factor that helps in reducing or minimising environmental impact resulting from IT use. According to the participants, this also helps in preventing computers from crashing and reduce energy consumption. They felt that this method was important because it is helping their organisations to tackle negative environmental impacts. However, in Figure 4.25 the theme, manual switching off the computer daily, is associated with task specific requirements. This could mean that the companies take into consideration the cost of energy of their computers because it has the potential to cause environmental damage. Therefore, manual switching off of computers is linked to energy savings and specific requirements of procuring computers.

IT not causing environmental harm: It was mentioned by the participants in Figure 4.5 that their IT operations were not contributing to environmental harm because they believe that their companies were making efforts by utilising various methods of technology to ensure the reduction or elimination of sensitive material of IT products that influence the environment. Traditionally, IT activities contribute negatively to the environment. Then again, the participants specified that delivery of their IT service and business value takes place without compromising the environment. In other words, they felt that determining environmental and health impacts provide value for their companies in the long run. In line with this view, they felt that their companies should utilise green technologies to help their companies to conserve natural environmental resources in order to correct the acceleration of carbon emission and achieve environmental sustainability. Perhaps not surprisingly, in Figure 4.4 the participants mentioned that their companies are contributing to the disproportionate burden of environmental degradation. The author believes that the participants have limited knowledge on Green IT. Therefore, the industries are not properly addressing ecological issues.

5.3.2 What method can be used to reduce the energy consumption as a result of green technology?

It was found in Figure 4.6 that the participants indicated that they utilise the following methods to reduce energy consumption as a result of green technology:

Promoting energy efficiency: It was specified by participants in Figure 4.6 that they analyse the energy costs that have implications for their business with the aim of improving energy efficiency because pieces of IT equipment consume lots of energy when they are not in use. From their perspective, they felt that it is essential for their companies to search for energy efficient products in order to reduce the business operational costs. In the same way, they felt that if the companies are not analysing costs it will eventually affect their profit margins. Therefore, analysing the business cost should be continuously evaluated. In the same context, it was found in Figure 4.7 that the participants indicated that cost saving and energy efficiency were a determining factor for purchasing their IT equipment. In a sense, they felt that investment in renewal energy is essential because it will result in competitive returns for their business and conserve the natural resources. In this regard, the promotion of energy efficiency is deemed to be an important driver to reduce energy consumption.

Furthermore, in Figure 4.8, the participants indicated that the rising cost of energy has prompted their organisations to start searching for efficient technologies to reduce business costs and improve energy efficiency. In a way, they felt that saving energy and resources can save their organisations, money in the future and preserve the environment. Therefore, Green IT adoption is the primary motivation for reduction of power consumption. However, a contradictory response was noted from the participants that they experience obstacles in minimising energy consumption because they are not receiving appropriate training regarding measures to reduce/minimise energy consumption that is caused by IT operation. Accordingly, training is vital for the organisations that have specific goals in improving energy efficiency. Fundamentally, it is a benefit to the organisations because it develops the skills of personnel and can encourage energy savings. Therefore, it should be thoroughly explored and implemented. Furthermore, it was also found in Figure 4.23 that cost savings/reduction is associated with the supplier being responsible for disposal. This could be described as having moral values to preserve the environment and reducing business costs by appointing the supplier to be responsible for their IT disposal. In contrast, Figure 4.35 indicated that purchasing of computers as needed is associated with uncertainty of the company analysing the cost implications to promote energy efficiency. This could be described as lack of knowledge and benefits of Green IT.

IT policy: The participants mentioned in Figure 4.6 that they have policies in existence that seek to promote energy savings. IT policy was stated as having the ability to articulate organisational values, strategies and providing guidance for the organisations in decision making. In fact, they felt that energy conservation ensures energy savings because IT is the driver for energy savings and innovation. In contrast, a large number in the same Figure 4.6 were of the view that their companies do not have IT policy while others were uncertain. According to the participants, their companies should make effort to develop IT policy in the most effective manner in order to promote energy savings. The author believes that there is lack of IT policy in the organisations. Therefore, this lack hampers the efficient use of energy within the organisations.

Task specific requirements: This was described by participants in Figure 4.6 as an important factor that influences their purchasing of IT equipment. According to the participants, it is not unusual for their companies to replace old computers with new ones. This replacement of computers with new ones helps in energy conservation and preservation of the environment. Furthermore, the participants viewed quality and reliability as significant elements that influence purchasing because their companies are dependent on performance and reliability of their IT equipment. Therefore, the task specific requirement was deemed to be the important driver of energy efficiency and alternative technology.

Greening data centres: The participants in Figure 4.7 were unsure of steps that their companies take to green their data centres to reduce operational costs. According to the participants, data centres are consuming a lot of energy and contribute GHG emissions and exacerbate environmental concerns. The participants described environmentally friendly data centres as an important driver for energy efficiency and alternative technology. On the contrary, some of the participants indicated that their companies are not taking steps to green their data centres. They felt that their companies are giving less attention to infrastructural issues that consume a lot of energy because it is unaffordable. Again, the participants felt that the cost of energy should be analysed in order to maximise energy efficiency and minimise environmental impact caused by data centres. It is believed by the author that there is lack of knowledge regarding the greening of data centres.

Conformance to international environmental standard: This was viewed in Figure 4.7 by the participants as an important influence in purchasing because their companies should comply with environmental regulations in order to address the environmental concerns that are caused by their IT products. They felt that their IT products should comply with applicable laws and other environmentally oriented requirements because it is important for their business. The conformance to international standard is therefore deemed to be an important driver for energy efficiency.

Outsource data management: According to the participants in Figure 4.7, outsourcing their company data management will contribute to energy efficiency because data centres' energy is a primary concern for organisations since it generates IT related costs. Accordingly, they felt that their companies should align their IT business objectives in a manner that is cost effective since outsourced data centres allow maximum freedom and flexibility in their daily IT operations. The author believes that there is lack of knowledge from organisations regarding data management. As a result, the organisations are outsourcing their data management.

Environmentally friendly fire retardants: This was described by the participants in Figure 4.7 as a benefit that will eventually reduce the possible impact of flammability within their companies.

Centralised servers: According to the participants, centralising the servers will benefit their organisations because the servers consume energy even when they are idling. According to them, this will abate environmental concerns caused by their IT use. The author believes that energy efficient technologies are not effectively explored. Therefore, energy consumption resulting from servers is not adequately adressed.

Server virtualisation: This has been mentioned in Figure 4.7 by participants as an energy efficient technology because it is important to relocate servers to virtual facilities. The participants acknowledged that this, in a way, will minimise potential detrimental effect to the environment and increase productivity. On the other hand, the participants felt that they have limited knowledge on greening data centres hence they outsource the management of data centres to external companies. According to them, outsourcing has its own challenges for their companies as well. The author believes that there is acknowledgement by organisations that there is lack of knowledge and capacity to manage servers and data centres.

Supplier being green: A factor that influences purchasing in Figure 4.7 was mentioned by the participants that they just buy from the suppliers that are going green because they believe that going green will eventually lead to environmental sustainability. It is believed by the author that there is limited knowledge of Green IT. Therefore, Green IT is inappropriately implemented by the organisations.

Minimise hardware: This was identified by the participants in Figure 4.7 as a benefit for energy efficiency because they will be able to closely control and protect their data. According to the participants, their companies should be able to manage both the hardware and their data. In the same Figure, the participants pointed to extend warranty as an important factor that influences purchasing because warranty promises to repair or replace pieces of IT equipment where necessary or applicable. Therefore, according to participants, the extension of IT product life is a significant green influence on the IT life cycle. In a way, they felt that the longer the IT product lasts the less impact it will have on the environment. It was also found in Figure 4.26, that the theme, IT does not consider the product life cycle and recycling issues upfront when buying computers and peripherals, is associated with occasional repair to increase life span outside warranty. On the contrary, in the same Figure 4.26 repairing hardware to increase life span and use parts from broken computers are associated with no steps being taken to change the status quo in minimising unnecessary hardware. The companies falling within this quadrant can be described as repairing their computers to minimise unnecessary hardware and prolonging their life span. The minimisation of hardware is therefore considered to be the important driver to reduce energy consumption. It is believed by the author that the organisations are not properly determining their IT product life cycle and they don't have recycling capacity.

5.3.3 What approach can be used in the design, production, operation and disposal of IT products in a manner that is not harmful to the environment?

In Figure 4.22 the participants indicated that they *utilise the service of an external company* for disposal of their obsolete pieces of electronic equipment to prevent stockpiling of e-waste. The participants acknowledged that they have limited knowledge of the disposal of obsolete pieces of electronic equipment. In the same light, it was also found in Figure 4.10 that the participants indicated that they viewed their companies as *lacking capacity to manage e-waste* through recycling. Therefore, they have transferred the responsibility to the supplier to ensure safe disposal of e-Waste. They felt that their companies are making minimal efforts to reduce e-waste because they repair and upgrade their computers occasionally. According to them, their companies outsource management of e-waste in order to focus on their core business. Interestingly, it was also found in Figure 4.22 that the participants indicated that *too much outsourcing* is the primary factor that hampers the implementation of Green IT strategy. They felt that outsourcing poses a serious challenge for their business because they don't have proper control over the operations. Furthermore, in Figure 4.31 *taking to the supplier* is associated with compliance with all policies and procedures. This could be described as managing waste effectively. It is believed by the author that the organisations lack capacity to manage e-waste. Therefore, this element should be thoroughly explored.

In Figures 4.10 and 4.11, the participants highlighted that *auction and donation* of computers is regarded as a way of dealing with obsolete electronic equipment and managing e-waste. It is believed by the author that auctioning and donation of redundant computers is not sufficient because it poses a further challenge to e-Waste management by the organisations receiving the donation or the buyers.

Then again, in Figure 4.10 the participants mentioned that *e-waste segregation and obsolete equipment are returned to the supplier*: The participants mentioned that they separate the components first before disposing of electronic equipment and return obsolete pieces of equipment to their supplier, trade them in or sell them to achieve financial returns. According to the participants, electronic gadgets contain harmful chemicals that have potential to contribute to environmental problems. They felt that e-waste is posing a challenge to their organisations. It is believed by the author that the organisations are successfully implementing important aspects of e-waste management.

It was found in Figure 4.11 that the participants pointed out that their companies are *repairing or upgrading before scrapping* is conducted. In view of this finding, they felt that their IT equipment should not be discarded but should rather be refurbished, upgraded, reconditioned and some of the electronic parts be replaced to prolong the life span of their IT equipment. According to the participants, this is another way of managing e-waste. However, in the same Figure the participants viewed selling of computers as scrap as providing their companies with some form of financial gain. Nevertheless, they don't recycle e-waste because they don't have the capacity to conduct it or manage it. Then again in Figure 4.32, the theme, no need for systems as IT does not cause environmental harm, is associated with obsolete equipment being returned to the supplier or traded. This could mean that the companies are utilising effective means to manage or control their e-waste. In Figure 4.26 the theme, human health benefit, is closely associated with the taking back to the supplier and refurbishing or reselling. This could be described as taking human health into cognisance by ensuring that they take back items to the supplier and increasing the life span of their IT equipments. It is believed by the author that upgrading and refurbishing to prolong the life span of IT equipment is not appropriately conducted by organisations. As a result, e-waste is not appropriately managed.

5.3.4 What strategies can be used to help IT contribute to environmental solutions?

In Figure 4.9 the participants mentioned that their companies purchase/look for energy saving devices that have been manufactured in an environmental fashion. Green technology products are playing a major role in the buying process because it helps their organisations to conserve the natural environment resources and lead to environmental sustainability. However, some of the participants mentioned that their companies were not purchasing energy saving devices.

Again in Figure 4.36, purchase computers as needed, is associated with uncertainty if the company analysed energy cost implications to promote energy efficiency. It was also found in Figure 4.9 that the participants described, considering IT product life cycle upfront, as an important driver during the buying process of computers and peripherals for their companies because IT product life cycle is a prerogative in the buying process for their companies. However, some of the participants mentioned that their IT departments do not consider IT product life cycle when procuring computers and peripherals. According to the participants, the buying process in the companies is taking place in an unstructured manner. It is believed by the author that purchasing of IT equipment does not consider IT product life cycle and the process is not properly coordinated.

It was found in Figure 4.9 that the participants described the upgrading of softwares and hardwares as a factor that plays a role in controlling e-waste. Replacing softwares with newer or better version in order to bring the system up to date to enhance characteristics is a benefit for their companies. They felt that upgrading or replacing the hardware provides an opportunity to increase the computer performance. Furthermore, the participants indicated that recycling, refurbishing and repairs of computers play an important role in extending the life cycle of electronic products and ensuring IT operations' compliance. According to the participants, the life span of computers is too short and most of them become obsolete and are used as spare parts. Again, the participants mentioned that their companies prefer to buy new IT equipment rather than increasing the life span beyond warranty. Once more, they felt that pieces of IT equipment that are not wanted should not be discarded but refurbished, upgraded or recycled to prolong the life span. Furthermore, software should be continuously upgraded to provide new version of programmes that have better stability to increase performance. In Figure 4.31 the theme, try to repair/upgrade before scrapping, is associated with using recycled or refurbished parts to machines. However, some of the participants in Figure 5.9 mentioned that they were not really upgrading their softwares. The author believes that the companies are frequently buying new computers rather than extending their life cycle.

In Figure 4.9, the participants mentioned that recycling was a factor that is utilised by their companies to prolong the life span of their pieces of equipment and reduce e-waste. The participants believe that their companies can recover precious metals and prevent hazardous waste through recycling. It was also found in Figure 4.15 that the participants indicated that recycling, refurbishing and repairs of computers play an important role in extending the life cycle of electronic products and ensuring IT operations compliance. It is believed by the author that the companies lack the capacity to conduct recycling of IT equipment in order to prolong their life span.

Business policies/regulations: The participants in Figure 4.12 indicated that their companies have business policies/regulations in place to address harmful environmental impact caused by IT use. According to the participants, their companies have established rules to conduct their business operation. However, some of the participants were uncertain about the existence of policies/regulations in their companies, while some indicated that they don’t have policies/regulations to mitigate harmful impact that is caused by IT operations. It was found also in Figure 4.13 that the participants viewed their company regulations and legislations as insufficient to protect the environment from IT related activities. However, in Figure 4.16 the participants mentioned that there is no need for a system because their IT department is not causing any environmental harm. It was also found in Figure 4.33 that the theme neutral/unsure on legislations/regulations that address environmental issues are associated with disagreement that there are business policies/regulations in place to address harmful impact caused by IT use. The companies which fall in this category are uncertain about legislations that address environmental aspects. The author believes that there is lack of policies/regulations that seek to address/mitigate harmful impact caused by IT operations

Compliance with policies and procedures: The participants highlighted in Figure 4.15 that they ensure compliance with all policies and procedures. On the contrary, in Figure 4.16, the participants mentioned that they are not ensuring compliance because of insufficient legislation dealing with e-Waste. They felt that their companies have no systems in place to minimise environmental impact caused by IT use. According to the participants, new regulation/legislation to manage e-Waste should be developed. It was also found in Figure 4.14 that the participants indicated that few IT regulations are linked to the environment because there is deficiency in the company regulations and legislations. However, in Figure 4.14 the participants mentioned that there is lack of formal penalty and the regulations are not enforceable because there is no legislation in South Africa that deals with e-Waste to protect the environment and improve quality of life. They stated that there is lack of policies that regulate handling and disposal of e-Waste. Furthermore, in Figure 4.16 it was found that the participants were not ensuring compliance because of insufficient legislation dealing with e-Waste. According to the participants, new regulation/legislation to manage e-Waste should be developed. It is believed by the author that there are insufficient legislations dealing with e-waste leading to poor compliance with e-waste management.

Conformance to environmental policies: the participants mentioned that they conform to the relevant environmental policies. They felt that it is important for their companies to create an environmental system to manage e-Waste. However, in Figure 4.16 the participants viewed government policies as being inadequate because they are more reactive than proactive. Furthermore, the participants mentioned in Figure 4.16 that they utilised ISO 14001 standard to address any environmental impact. According to the participants, ISO 14001 standard helps the organisations to improve their environmental performance. In Figure 4.32, the theme ISO 14001 is associated with, sold as scarps and no recycling company, being used. The companies could be described as having effective management system to deal with e-waste. Furthermore, in the same Figure 4.16 the participants mentioned that they utilised ISO 9001 to improve on quality. According to the participants, ISO 9001 standard helps the organisations to improve their business performance. Again in Figure 4.32, the theme ISO 9001 is associated with batteries of laptops being collected by external company and does not have obsolete computers. This could mean that the companies are effectively managing their e-waste. It is believed by the author that there is poor compliance with environmental policies because of inadequate policies and regulations.

Reliance on internal environmental department: This was described by participants in Figure 4.14 as a factor that ensures compliance in preservation of the environment. According to the participants, their companies should develop new ways to comply with environmental regulations in order to address environmental concerns caused by IT activities. Similarly, it was also found in Figure 4.15 that the participants indicated that interdepartmental support within their organisations plays a big role in ensuring compliance with environmental laws and code of practice for IT operations. The author believes that there is poor compliance with environmental regulations.

Internal and external audits: Participants in Figure 4.15 viewed their companies as ensuring compliance with relevant environmental laws and code of practice for IT operations because they conduct internal and external audits utilising the international standards such as ISO 14001. The participants stated that their companies should comply with environmental regulations to create environmental sustainability. It was also found in Figure 4.16 that the participants mentioned that auditing energy consumption is an important factor in minimising environmental impact. Again in Figure 4.32, the theme, conforms to relevant environmental policies and auditing energy consumption, is associated with external company being responsible for e-waste disposal. The organisations can be described as having effective measures in place to control their e-waste. It is believed by the author that internal and external audit takes place in the organisations. However, these environmental regulations are not related to IT activities.

Train/educate staff: This was specified in Figure 4.16 as a benefit to minimise environmental impact caused by IT use. However, in Figure 4.14 the participants mentioned that there is lack of awareness among the staff members regarding the regulations which are not publicly available. Some of the participants did not provide any reason. It was also found in Figure 4.15 that the participants believed that training on policies and procedures should be provided to all employees. Similarly, training was noted in Figure 4.18 as playing a significant role in the quick implementation of Green IT. Furthermore, in Figure 4.22, the theme, the *staff not adapting to their work habits without supervision,* was described by participants as an element that is causing the collapse of their Green IT strategy. The participants felt that their staff are inadequately trained. Again in Figure 4.32, the theme, train/educate staff, is associated with try to repair/upgrade before scrapping, supplier responsible for disposal and refurbish/resell. Training of staff was therefore deemed to be the important driver to address environmental issues. It is believed by the author that there is insufficient training regarding environmental regulations and Green IT implementation.

5.3.5 What sources can be used to determine the impact of adoption of strategic Green IT towards creating a sustainable environment?

In Figure 4.19 the participants indicated *environmental concerns* as a factor that drives the adoption of Green IT for their companies. According to the participants, the protection of the environment and promoting sustainability for future generations is important because there is growing awareness of sustainable development and environmental protection. In a similar way, it was also found in Figure 4.22 that the participants described reduced environmental impact as the primary factor that demonstrates return on investment. They felt that the protection of the environment is the key factor in improving business performance for their companies. Environmental concerns are considered to be an important driver for the adoption of strategic IT in order to create a sustainable environment.

The participants identified *cost reduction* in Figure 4.19 as the driver for Green IT implementation. According to participants, the cost of energy and environmental concerns introduced challenges for their companies. Therefore, their companies are searching for efficiency and reduction of business costs. On the contrary, the participants mentioned that the initial costs for Green IT implementation were very high but cost effective in the long run. Similarly, in Figure 4.22 some of the participants viewed decreasing of costs as the main driver that *demonstrates return on investment* for their companies. According to the participants, decreasing the costs of doing business can lead to substantial savings for the companies and improve energy efficiency that will lead to reduction in pollution. On the contrary, some of the participants viewed the initial start-up cost for Green IT implementation as being high. They felt that their companies do not embrace green because it is not affordable for them. However, in Figure 4.20 the participants indicated that the benefits for Green IT implementation outweigh the cost, although, some of them pointed out that there is no difference in costs of implementing Green IT. Outsourcing in Figure 4.20 was described as a way of reducing cost of doing business. Furthermore, the participants mentioned that Green IT implementation results in *saving of energy and maintenance cost*. However, some of the participants did not provide reasons. In Figure 4.35, the theme cost reduction is associated with corporate social responsibility requirements being fulfilled. This could be described as reducing the cost and meeting the corporate social responsibility obligation. Again in Figure 4.37, Green IT being and investment for the company, is associated with decreased costs, client satisfaction and system efficiency. Moreover, in Figure 4.27, the theme, green and money, is associated with cost and environmental benefits. The cost reduction is therefore considered to be the primary driver for Green IT adoption. The author believes that reduction of business cost is the primary reason that the organisations are adopting Green IT more than environmental concerns.

On the other hand, the participants in Figure 4.19 viewed *improving company image and reputation* as an important driver for Green IT implementation. According to the participants, their companies are likely to experience improved reputation, trust and competitive advantage through supporting green. The participants in Figure 4.22 mentioned client satisfaction as another factor that demonstrates return on investment for Green IT implementation for their organisations. According to the participants, fulfilling customer expectations yields positive results for their business. The improvement of company image is deemed to be an important driver for Green IT adoption.

Then again, in Figure 4.19, *competition with other companies* was described by the participants as the driver for green IT. According to participants, competition has an influence on Green IT implementation. However, in Figure 4.22 the participants mentioned increased collaboration as an element that demonstrates return on investment for Green IT implementation and business value. In the same way, in Figure 4.17 the participants indicated that Green IT is an investment for their companies. They felt that investment in renewal energy is essential because it will result in competitive returns for their companies in some of the business markets. The author believes that some companies are behind and missing out on the opportunities. Green IT can provide companies with a competitive edge.

In Figure 4.20, the participants pointed out that the strategy used by their companies to address business computer needs is linked to *conduct research of IT needs*. According to the participants, the strategy provides clarity and focus for their companies. Moreover, the participants indicated that their companies purchase computers according to business needs. On the contrary, in Figure 4.22 the participants indicated that the lack of research before purchasing is a contributory factor to the failure of Green IT implementation. According to them, conducting research before purchasing is critical towards successful Green IT strategy. They felt that their IT systems should match business requirements for the successful implementation of Green IT. Conducting research for IT needs is therefore deemed as an important driver for Green IT strategy. It is believed by the author that the companies are not conducting research for their IT needs. As a result, this hampers their Green IT implementation.

Again, in Figure 4.22 *energy saving choices* was named by participants as one of the elements preferred by their organisations for successful Green IT implementation. According to the participants, sensor installation, going wireless, using green plugs, using LCD/LED monitors and UPS and generator for server room can deliver immediate benefits for their companies for Green IT implementation. Moreover, the use of fax to email and reliable brand choice is a contributory factor to the successful implementation of Green IT. Furthermore, in the same Figure 4.22 the participants mentioned that *reliance on paper copies* and not digital copies was hindering the success of going green. According to the participants, going digital has enormous benefits for their companies. Therefore, printer reduction in Figure 4.18 was viewed as a key element for quick wins of implementing Green IT programme. However, in Figure 4.22 the participants mentioned that *outsourcing printing* was another contributory factor to the success of Green IT strategy. On the other hand, it was discovered in Figure 4.34 that the theme, human health benefits and sustainable future, is associated with green plugs. The companies falling into this category could be described as utilising green products to prevent adverse health effects and ensuring environmental sustainability. Energy saving choices is therefore considered, to be an important factor in Green IT adoption.

It was found in Figure 4.22 that the participants named *system efficiency* as a contributor to demonstrate return on investment. This helps the organisation to seek alternative clean resources to improve their efficiency by designing technologies that are less harmful to the environment. The participants felt that their companies could reap some benefits through system efficiency. Similarly, in Figure 4.18 the participants mentioned natural resources as an immediate benefit for Green IT implementation because it is important to reduce carbon emission and increase the use of natural resources. Therefore, system efficiency is an important source to determine the impact of strategic Green IT adoption towards creating a sustainable environment.

Furthermore, in Figure 4.18 and 4.20, the participants mentioned that *purchases must be green compliant* because they have potential benefits for the company. According to the participants, green should be embraced or supported because it will provide quick wins for Green IT implementation. However, in Figure 4.20 some of the participants pointed out that their companies were not going green because they don't see the value of Green IT adoption. Green purchase is deemed to be an important driver towards creating a sustainable environment. The author believes that Green IT implementation remains a challenge for some of the organisations.

IT budget in Figure 4.20 was described by participants as playing a critical role in addressing growing computing needs. According to the participants, IT plays a central role for business results. Therefore, sufficient budget is the determining factor for successful Green IT implementation. However, in Figure 4.22 the participants indicated that lack of IT budget on company technology inhibits the effectiveness of Green IT strategy. They felt that IT operations are not adequately supported in finances. Sufficient IT budget is considered an important driver for strategic Green IT implementation.

Management support in Figure 4.18 was viewed as an important element for instant benefit of Green IT implementation. In the same way, in Figure 4.20 management support and IT manager making decisions was described by participants as an important driver to address growing computer needs. According to the participants, the IT manager has control over the budget and management support is a critical factor in the success of Green IT implementation. Correspondence analysis in Figure 4.36 shows that IT manager makes decision on purchases is associated with analysed energy cost implications to promote energy efficiency. However, in Figure 4.20, some of the participants mentioned that there is no strategy, drive or impetus to address growing computing needs. Management support is considered to be playing a critical role for Green IT implementation. The author believes that there is lack of management support for some of the organisations to ensure proper implementation of Green IT.

Cost effective suppliers with good technical support in Figure 4.22 was mentioned by the participants as specific elements that their companies viewed as a successful factor for Green IT implementation. According to the participants, good technical support and cost effective supplier is beneficial to their companies for efficiency and effectiveness of their business operation. Cost effective suppliers with good technical support is considered an important factor of strategic Green IT towards creating a sustainable environment.

The participants mentioned in Figure 4.20 that their companies *automatically replace the computers* every three years because the life span of computers is between 4-5 years. In line with this finding, they felt that most of the computers become obsolete before losing capacity and they are used for spare parts. However, it was found in Figure 4.22 that the participants mentioned that clear processes and standards are required when *replacing legacy equipments.* They felt that this is beneficial for the successful implementation of Green IT for their companies. Replacement of computers is considered as playing a major role in the adoption of strategic Green IT towards creating a sustainable environment.

Then again, in Figure 4.22 the *frequent crashing of computers* was described as a negative factor that impedes the Green IT implementation. The participants felt that the crashing of computers contributes significantly to operational costs and leads to failure of Green IT strategy. Furthermore, the participants viewed using *outdated equipments* for some applications as a factor that is posing a challenge for the success of their company Green IT strategy. The participants felt that their companies should use current and relevant equipments for some of their applications. Therefore, *increasing IT life span* in Figure 4.20 was pointed out by participants as their companies' strategy for addressing computing needs and increasing the IT life span. They felt that IT equipment should be reused, refurbished and upgraded to prolong their life span and ensure more efficiency of resources eventually providing business solution for growing computing needs. However, in Figure 4.22 the *cost of repairs* was considered to be expensive by participants because local brands are less durable and they rely on desktop PC's. The participants felt that this is contributing to their failure in the Green IT implementation. Increasing IT life span is deemed to be an important driver for adoption of strategic Green IT towards creating environmental sustainability.

Participation of employees in Green IT implementation in Figure 4.21 was mentioned by the participants as their companies involve them to make Green IT part of their company culture. The participants felt that Green IT implementation should be developed by engaging the relevant stakeholders. However, some of the participants felt that their companies are not involving them in participating to a certain extent. Therefore, without their participation in Green IT implementation there is limited success. Participation of employees is essential for strategic Green IT. It is believed by the author that there is lack or poor participation of employees in Green IT implementation in the organisations.

Knowledge of IT personnel to implement Green IT in Figure 4.21 was described by the participants as an important factor in Green IT implementation. According to the participants, knowledge of Green IT is vital in ensuring the success of the Green IT programme. Therefore, they felt that their IT personnel have capacity to adapt to new technologies. On the contrary, some of the participants viewed their companies as having limited knowledge on Green IT. According to the participants, their IT personnel do not possess the necessary skills and knowledge to ensure successful Green IT implementation. As a result, this is inhibiting the success of Green IT implementation. On the contrary, in Figure 4.18 the participants viewed recruitment of IT personnel as an instant benefit that can deliver quick results for Green IT implementation. The recruitment and knowledge of IT personnel to implement Green IT is considered to be an important factor in the Green IT adoption. The author believes that the IT personnel have limited knowledge of Green IT implementation.

The development of *IT policy* in Figure 4.18 was mentioned by participants as imperative to reap the immediate benefits of Green IT implementation. In Figure 4.22 participants viewed uncoordinated implementation and lack of defined strategy for Green IT as impeding the success of its implementation. The participants felt that their companies do not possess the necessary knowledge to implement the Green IT strategy. Furthermore, they highlighted *uncertainty of any return on investment* as a factor that delimits the demonstration of return on investment for Green IT implementation. In the same vein, in Figure 4.19, the participants mentioned that there are no factors driving the adoption of Green IT for their companies. However, some felt that there is lack of motivation or limited understanding of Green IT adoption. Hence they are unaware about the reasons that drive their companies to adopt Green IT. The development of IT policy and Green IT strategy is considered important factors in the strategic Green IT towards creating a sustainable environment. It is believed by the author that there is lack of policies and strategy for Green IT implementation amongst the organizations.

Vendor management fitting into business strategy in Figure 4.22 was described by participants as a factor that will lead to competitive advantage for their business. This will help the companies to develop strategic plans that are based on long term objectives leading to financial benefits and environmental sustainability. On the contrary, some of the participants were uncertain about their vendor system fitting into the business Green IT strategy. According to the participants, this is an element of deficiency in managing the vendor. It is believed by the author that vendor management does not fit into the business strategy of some of the organisations. As a result, this impedes the Green IT implementation.

5.4 SUMMARY AND CONCLUSION

In Chapter 5 the interpretation of the case studies was described and the results were indicated. The use of correspondence analysis assisted in authenticating the general interpretation of the results. Furthermore, the use of correspondence analysis was used to gain better insight into the analysed data. The findings of this study have addressed the research problem by achieving the research objectives of developing a framework for Green information technology implementation in South African organisations. The study highlighted the technology that can be optimised to address ecological issues, energy efficient and alternative technologies that can be utilised, e-waste management that can be applied by organisations, legislations and regulations to address environmental issues and a framework that can be used for Green IT implementation.

The next chapter discusses the findings from South African organisations and the content of the relevant literature. A Green IT framework is developed.

CHAPTER 6: FINDINGS AND DISCUSSION OF DATA

6.1 INTRODUCTION

This chapter discusses the findings from South African companies. These findings are analysed and presented in the context of the relevant literature. The SPSS programme and Correspondence analysis were used to compute the information and generate the graphs. In context, this particular technique used for analysis and interpretation of data has the potential to affect the results.

6.2 DISCUSSION OF FINDINGS

The following section discusses the findings of the study.

6.2.1 Contextual background on Green IT

The results revealed that going green and using eco-friendly system for the companies is related to cost saving, environmental benefit, human health and corporate social responsibility. The primary impetus for the companies to adopt Green IT is mainly related to reducing the business expenses and protecting the environment. In essence, Green IT adoption is connected to cost effectiveness and environmental sustainability. This means that the companies adopting Green

IT have the potential of creating a fertile ground for economic prosperity for their organisations. The rationale for Green IT implementation is because it is connected with the sense of environmental awareness which is a concern for the ecosystem in which humans exist (Tomlinson, 2012:2).

Green IT is regarded as the critical contributor to a sustainable development in ensuring corporate social responsibility. Therefore, it is imperative for organisations to ensure that green IT is compliant with corporate social responsibility, consequently ensuring that business operations do not violate the law. Essentially, the delivery of IT service should take place without compromise to the environment. Previous studies indicate that green technologies should help the organisations to conserve the natural environment resources in order to achieve environmental sustainability (Sinha, 2011). This can be realised through effective use of IT resources to correct the accelerating rise of carbon emission (Chong et al., 2010:84). In principle, the primary motivation for Green IT adoption is to save money (Clarke, 2009:19).

In Green IT context, it is an investment for companies because it can result in competitive returns in some business markets. The underpinning of its adoption is because it is affordable for organisations and should be supported and embraced. However, some companies are still behind and missing out on opportunities.

6.2.2 Drivers for Green IT

The growing awareness of sustainable development and adoption of Green IT has become a subject of concern across the world for environmental protection (Chuang and Huang, 2014). Studies reveal that the driving force for Green IT adoption by organisations is primarily ethics and environmental concerns (Kuo and Dick, 2009:83). In line with the findings of the study, the following are drivers for Green IT:

Environmental protection: The study showed that the factors driving the adoption of Green IT for companies are related to environmental protection and promoting sustainability for future generations.

Cost reduction: The cost reduction is the driving force for Green IT adoption because the environmental awareness has introduced challenges for the organisations and prompted searches for efficiency and reduction in business costs.

Company image: The study revealed that improvement of the company image and reputation is the primary driver for Green IT implementation. It is acknowledged by the research study that the implementation of Green IT is likely to improve the image of the companies.

Competition: The study indicated that competition with other companies is the primary driver for Green IT adoption. Competition, legitimation and social responsibility influence Green adoption (Kuo and Dick, 2009:83).

Corporate social responsibility: The study showed that organisations are likely to experience improved reputation, trust and competitive advantage through corporate governance. In view of the literature, corporate social responsibility motivation is based on the sense of obligation, responsibility or philanthropy rather than self-interest (Kuo and Dick, 2009:83).

6.2.3 Impact of IT related products on the environment and health

The results disclosed that ecological issues of IT products and service design need to be addressed in order to deal with pollution that is responsible for increases in atmospheric concentrations and environmental degradation. There was an element of uncertainty from the participants that the use of IT is contributing to carbon emission. Essentially, carbon emission is dangerous to the health and wellbeing of the people and the environment. Therefore, companies must determine ecological impact that is caused by IT. Adopting eco-sustainable approaches by organisations will help to abate pollution and protect the environment from fragility of the earth‘s ecosystem and the potential of irreversibility of climate change.

IT has the potential to cause environmental harm. Therefore, it is important to preserve the environment by reducing IT activities which are continually degrading the environment. Research studies indicate that IT can play a significant role in the global effort of reducing the impact of human activities on the environment (Huang, 2009:114-115). Therefore, environmentally sound IT should not be dangerous to the health and wellbeing of the people and the environment. In context, Green IT implementation should provide value for businesses by enabling carbon efficiency, processes, systems, technologies and work practices.

6.2.4 Development and implementation of green IT into business strategic plans

The study revealed that there is deficiency in companies to develop and implement Green IT into business strategic plans. The research study discovered the following findings from the organisations:

Conducting research: The strategy used by companies to address growing business computer needs is linked to conducting research for their IT needs and through reports. Therefore, conducting research means providing clarity and focus for the company. It was evident from the study that organisations are not conducting research before purchasing. The lack of research before purchasing of IT equipment is impacting severely on the business strategy. Furthermore, IT system that does not match the business requirements impedes the Green IT strategy. Therefore, haphazard implementation of Green IT or lack of defined strategy leads to failure in Green IT.

Management support: Management support is an important element for instant benefits of Green IT implementation. The study revealed lack or inadequate management support in Green IT implementation. Typically, the company's top management that makes the decision regarding the company direction plays a critical role in development and implementation of Green IT. In context, management support is a critical success factor for the company. The lack of management support results in failure for Green IT implementation.

Involvement of employees: The study revealed that employees are not fully involved in Green IT implementation. It is important for employees to be involved in order to make Green IT part of their company culture. In view of the literature, Green strategy should be developed by engaging stakeholders (Bose and Luo, 2011:42). Inadequate involvement of employees inhibits the success of Green IT.

IT Budget: The study revealed that IT budget plays an important role. This implies that IT plays a central role in the development and implementation of Green IT into business strategic plans and business result. Therefore, it is important for IT department to have control over its budget because limited IT budget is a constraint for effective Green IT strategy.

Cost effectiveness and technical support: Cost effectiveness and good technical support is an important factor for the development and implementation of Green IT into business strategic plans.

Business policies/regulations: The result showed that there is little or no effective enforcement of business policies/regulations. Research studies indicate that there is no legislation in South Africa dealing with e-Waste to protect the public and the environment in order to maintain and improve the quality of life (Advanced Tropical Environment, 2012:26; Khurrum et al., 2011:3).

Therefore, ecological issues are not appropriately addressed. From the environmental point of view, the organisations are relying on internal environmental department to ensure compliance in preserving the environment. The organisations should develop business policies/regulations and new ways to enhance competitiveness and comply with environmental regulations to mitigate harmful environmental impact caused by IT use.

Governmental policies: The study revealed that government policies are inadequate and they are reactive rather than proactive. Furthermore, there is lack of awareness among staff members regarding the regulations that are not publicly available. The government policies that address environmental issues caused by IT use should be developed and incorporated into business strategic plans.

Environmental law: The study showed that the companies are ensuring compliance with relevant environmental laws and code of IT operations by conducting internal and external audits following the ISO 14001 standard, thus creating a hope of reaching environmental sustainability. Environmental legislations play a significant role in ensuring IT operations compliance.

ISO 14001: The companies should minimise environmental impacts. As a result, ISO 14001 standard implementation can help the organisations to improve their environmental performance. It is imperative for organizations to create an environmental system that includes organizational structure, planning activities, responsibility, practice, procedure, processes and resources for developing, implementing, achieving, reviewing and maintaining environmental policy as indicated in the ISO 14001 standard to manage e-Waste (Chou and Chou, 2012:450).

Training on policies and procedures: The companies should train their employees on policies and procedures to ensure compliance. The study reveals that there is a need for training of employees regarding policies and procedures. Training and education of staff is beneficial to minimise environmental impact caused by IT use.

Outsourcing printing function: The study revealed that outsourcing contributes to the success of Green IT strategy. However, too much outsourcing hampers the Green IT strategy.

Vendor management: The study reveals that the companies' vendor management was not fitting into the business of Green IT strategy for green technology solutions. This is in contrast with previous literature that organisations should have green visions and strategic plans that are based on long term objectives for business to gain competitive advantage through the reduction of IT operational cost leading to environmental sustainability (Campbell, Ratcliffe and Moore, 2013:132; Chong et al., 2010:84).

6.2.5 Evaluating the approach to Green IT

The following are the approaches to Green IT implementation:

Recruitment of IT personnel: The companies should recruit IT personnel that are knowledgeable and competent to implement Green IT.

IT Personnel competency: The study revealed that the IT personnel have limited knowledge and understanding of implementing Green IT. It is imperative for IT personnel to have the necessary knowledge, experience and competency for the success of Green IT implementation.

IT policy: The study revealed that there is lack of IT policy. Accordingly, IT policy is imperative for successful Green IT implementation.

Training: The study revealed that there is insufficient training to minimise energy consumption. The organisations should train their employees to ensure successful Green IT implementation.

Natural resource: The study revealed that natural resource relates to immediate benefit of Green IT implementation. The review of literature indicates that GHG reduction is needed at a global level to halt the loss of biodiversity and increase prudent use of natural resources (The Editors, 2009:7).

Reduction of power consumption: Going green is related to reduction in power consumption. In reality, energy conservation has become the corner stone of going green. The rising cost of energy and environmental awareness have introduced challenges globally, prompting for searches for efficiency and cost reduction caused by IT (Chawla, 2013:3). Research studies indicate that saving energy and resources can save the organisation money in the long run (Buckby, 2008).

Centralise servers: The servers should be centralised for communication purposes and hardware should be minimised. Research studies highlight that 90% of the servers remain idle and consume energy, in consequence generating carbon that is hazardous to the environment and contributing to climate change (Uddin and Rahman, 2012:4083). The companies should closely manage both the hardware and data itself.

Server virtualisation: The companies should use modern virtual servers and use few servers. It is important to relocate physical servers to virtual facilities in order to minimise any harmful environmental impact.

Fire retardants: This has a potential to reduce the possible impact of flammability. Therefore, companies should use environmentally friendly fire retardants.

Green data centres: The companies indicated limited knowledge about greening their data centres. Less attention is given to infrastructural issues including energy consumption, cooling and space for data centres because they are considered unaffordable (Vykoukal, Wolf and Beck, 2009). Previous studies indicate that the current energy consumption in data centres is contributing to annual increase of the GHG and exacerbates environmental changes (EPA Report, 2009). The cost of energy is gradually increasing to run IT infrastructure that is caused by expansion of data centres resulting in carbon foot print and escalating the business costs. The data centres should be built in an environmentally friendly way. Therefore, companies should ensure that data centres should maximise energy efficiency and minimise environmental impact.

Outsource data management: The companies should align their business objectives in a manner that is cost effective because outsourced data centres allow maximum freedom and flexibility. Data centre energy and emissions have become a concern in green IT analysis because it generates half of all IT related costs (Ruth, 2009:75).

Printing reduction: The study indicated that printing reduction is important for successful Green IT implementation. Reliance on paper hard copies rather than digital copies impedes the success of going green.

6.2.6 E-waste management

Previous research studies indicate that electronic products have gained popularity and organisations have stockpiled e-Waste because they don't know how to dispose of it (Saphores et al., 2009:3). It is evident from the study that e-Waste is an emerging problem for the organisations. Thus organisations are encouraged to reuse and recycle.

Reuse and recycle: The organisations should be encouraged to reuse, remanufacture and recycle IT products in order to reduce harmful environmental effects because the life span of IT products is shorter between 4-5 years. Therefore, some IT pieces of equipment become obsolete before their end of life span. It is evident from the study that the companies lack capacity in recycling. As a result, the companies should outsource the recycling to the organisations that are competent to recycle. This means that the companies will separate and dissemble components and raw materials of waste electronics. In a way, the company can recover precious metals and prevent hazardous waste. Thus, the organisations will be able to maintain their focus on their core business.

Repair/upgrade: The organisations should try to repair/upgrade their computers before scrapping them. This will prolong the life span of their IT equipment and reduce on e-waste. Furthermore, it enhances performance of computers and has the potential to reduce cost of business. However, the cost of repairs is somehow expensive. It was evident that repairs and upgrade were not properly addressed.

Donation of computers: Redundant computers should not be discarded but should be donated to charity organisations.

E-waste segregation: The companies should separate all the electronic components to reduce impact on the environment because electronic gadgets contain multitudes of toxic metals and chemicals.

Return to supplier/Trade: The organisations should return all pieces of obsolete equipment to the supplier or trade them. By selling pieces of IT equipment the organisations can achieve some financial returns.

Safe disposal: Organisations should ensure safe disposal of e-Waste. It is evident from the research findings that many companies have limited knowledge on e-waste management and do not have the capacity to manage their e-Waste. Therefore, there should be clear process and standards when replacing legacy equipments in the companies.

6.2.7 Measures that can be used by organisations to implement Green IT

The results indicate that the companies should purchase green products that are environmentally friendly because the process involves making trade-offs between environmental impact and business costs.

IT policy: The study revealed that there is a lack of IT policy. This policy should be in existence to promote energy savings. Inadvertently, this will articulate organisational values, strategies and guidance for the organisation in decision making. Therefore, efforts should be made to administer IT policy in the most effective manner to promote energy savings.

Energy cost analysis: Cost should be analysed by IT managers in order to promote energy efficiency. IT equipments consume more energy efficiency when they are not in use. Failure to analyse the cost of energy has implications to the organisations' profit margins. IT departments are responsible for managing computer networks, but they do not pay electrical bills. Therefore, the organisations should search for energy efficient technologies in order to reduce the business costs. Cost analysis should consistently be evaluated by the organisations.

Manually switch off the computers: This prevents the computers from crashing and consuming high level of energy. Machines with external power suppliers draw current, even when they are switched off. Unless the devices have recognised environmental certification or label, or sleep mode they burn at least half as much power when they are idling or working flat out. Energy conservation ensures energy savings because IT has become the driver for energy saving and innovation (Murugesan, 2011:46). Previous studies highlight that energy efficient technologies are important for the organisations to help them reach climate goals and ensuring reduced environmental impact (Borggren et al., 2013:126).

Use of Bio plugs: Energy saving choices were preferred by the companies. It is acknowledged that programmes that are in support of energy efficiency should be launched to enhance economic growth and abate GHG emissions (Vine and Hamrin, 2008:467).

Using UPS and generator: To prevent possible power interruption and providing emergency power to a load when the input power fails, the companies should use UPS and generators. Research studies indicate that organisations should find alternative clean resources to improve efficiency through the design and use of advanced technology for environmental sustainability (Ramayah et al., 2013:246-247).

Reduce printing: Printing is contributing to the escalation of energy and business costs. Therefore, companies should reduce on printing. Organisations should reduce the number of unnecessary prints by reviewing and sharing documents on screen and print on demand only.

IM communication: The companies should use IM communication in order to reduce on travelling because travelling contributes to environmental damage through carbon emission.

IM communication allows people far away from each other to work together and reduce environmental impact from travelling to meet with other.

Training: The managers and employees should receive appropriate training to reduce/minimise energy consumption caused by IT operation. Training has specific goals in improving energy efficiency and is beneficial for the organisations in ensuring IT energy savings. Energy efficiency is not part of IT professional's training. Hence the time it takes to research energy saving strategies, tools and techniques is often significant enough to serve as a barrier to action. Furthermore, IT professionals are expected to act beyond their competency limiting the successful implementation of Green IT (Walker, 2017).

Safe e-waste disposal: Improper disposal of obsolete IT equipment is contributing negatively to the environment. Therefore, the companies should ensure safe disposal of old equipment. Previous studies indicate that effective and efficient procedures for managing e-Waste are a daunting task for the organisations (Advanced Tropical Environment, 2012:14). It was evident from the study that e-waste is not properly disposed of.

Procurement: The companies should look for specific requirements or features when buying computers. Cost is the determining factor when purchasing IT equipment. Organisations should change procurement or operational systems when buying computers by including environmental questions in their purchase request. These environmental questions include IT products recyclability, energy efficiency and avoidance of harmful chemicals. Literature review highlights that it is not unusual for companies to replace their old computers with new ones in order to conserve energy and become environmentally sustainable (Kurp, 2008:13).

Green focus: Companies should focus on green or energy saving in their buying requirements. Green should be the primary driver for procurement of IT equipment. The organisations should buy from the suppliers that are going green. However, it was evident from the study that Green IT is not properly implemented.

Quality and reliability: The companies should look for quality and reliability when buying. The companies are dependent on performance and ability.

Energy efficiency: Energy use and efficiency is the primary factor that influences purchasing for the organisations. It is important for organisations to find alternative clean resources to improve energy efficiency through the design and use of advanced technologies for environmental sustainability (Mattern, Staake and Weiss, 2010; Rahim and Rahman, 2013:241). The companies should use environmentally friendly/power usage or energy start products that have been manufactured in an environmental fashion. Improving energy efficiency will eventually lead to reduced pollution and saving money. Organisations are aggressively pursuing Green IT strategies to reduce costs because of the global economic downturn (Data Monitor, 2009). The organisations should find alternative clean resources to improve energy efficiency through the design and use of advanced technologies for environmental sustainability (Andreopoulou, 2012:1; Chowdry, 2012:639).

International environmental standards: The organisations should also look for products/equipment that conform to international environmental standard to enhance their competitiveness and comply with environmental matters.

Extended warranty: The longer the products last the lesser the impact on the environment due to disposal. Therefore, the companies should take cognisance of extended warranty because it promises to repair or replace where necessary. The extension of IT product life cycle is a significant green influence.

IT product life cycle: The organisations should consider the IT product life cycle issues upfront when buying computers and peripherals. This should be a prerogative for the companies since the goals of Green IT extend to the product's use over its life cycle and eventually resulting in recycling, reuse and biodegradability of obsolete products. The management of IT should be approached in a structured manner through its life cycle and buying process.

6.2.8 Developing framework for Green IT

The research objectives have been addressed by the findings and supported by literature as highlighted below. The framework is based on the findings that have been statistically developed and tested. The findings have highlighted that the primary drivers for Green IT are the following:

6.2.8.1 Green IT drivers

The findings have highlighted that the primary drivers for Green IT are the following:

- Environmental protection
- Cost reduction
- Company image
- Competition

- Corporate social responsibility

6.2.8.2 Impact of IT related products on the environment and health

The findings have highlighted that the impact of IT related products on the environment and health are the following:

- Pollution
- Carbon emission
- Ecological issues
- Environmental degradation
- Climate change

6.2.8.3 Development and implementation of Green IT into business strategic plans

The findings have highlighted the following as measures that can be used to develop and implement Green IT into business strategic plans:

- Management support
- Conducting research
- Involvement of employees
- IT Budget
- Cost effectiveness and technical support
- Business policies/regulations
- Governmental policies
- Environmental law
- ISO 14001
- Training on policies and procedures
- Vendor management
- Outsourcing printing function

6.2.8.4 Evaluating the approach to Green IT

The findings have highlighted the following approaches for successful Green IT implementation:

- Recruitment of IT personnel
- IT Personnel competency

- IT policy
- Training
- Natural resource
- Reduction of power consumption
- Centralise servers
- Server virtualisation
- Fire retardants
- Green data centres
- Outsource data management
- Printing reduction

6.2.8.5 E-waste management

The findings have highlighted that e-waste can be managed by doing the following:

- Reuse and recycle
- Repair/upgrade
- Donation of computers
- E-waste segregation
- Return to supplier/Trade
- Safe disposal

6.2.8.6 Measures that can be used by organisations to implement Green IT

The findings have highlighted measures that can be used by organisations to implement Green IT as follows:

- IT policy
- Energy cost analysis
- Manually switch off the computers
- Use of Bio plugs
- Using UPS and generator
- Reduce printing
- IM communication
- Training
- Safe e-waste disposal

6.2.8.7 Procurement / Purchasing

The findings have highlighted that the following procurement process should be followed:

- Specific requirements
- Green focus
- Quality and reliability
- Energy efficiency
- International environmental standards
- Extended warranty
- IT product life cycle

6.2.8.8 Green IT Framework

Green IT framework is an essential supporting structure that ensures a practical approach for successful Green IT implementation. In other words, it provides guidelines that can be used or modified for Green IT implementation. Figure 6.1 displays the Green IT Framework that can be used to ensure that Green IT is implemented successfully within the organisations.

6.2.8.9 Process flow of Green IT implementation

This process flow is a method that documents the stages that should be involved in implementing Green IT. It is a flow chart that shows inputs or information that is followed by each step to create deliverable output of Green IT implementation. Figure 6.2 displays the process flow that should be followed by organisations to ensure successful Green IT implementation.

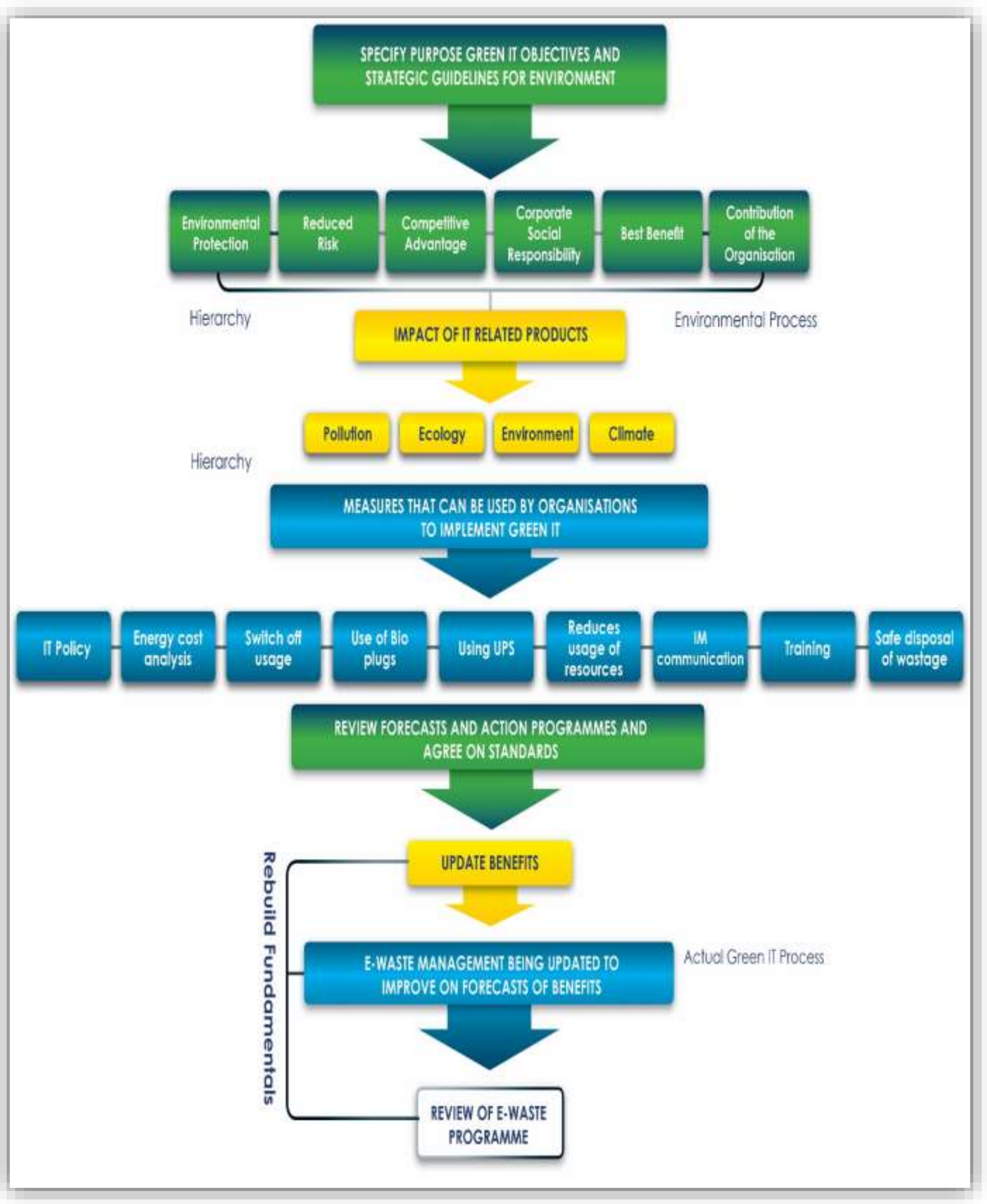

Figure 6.1 Green IT Framework

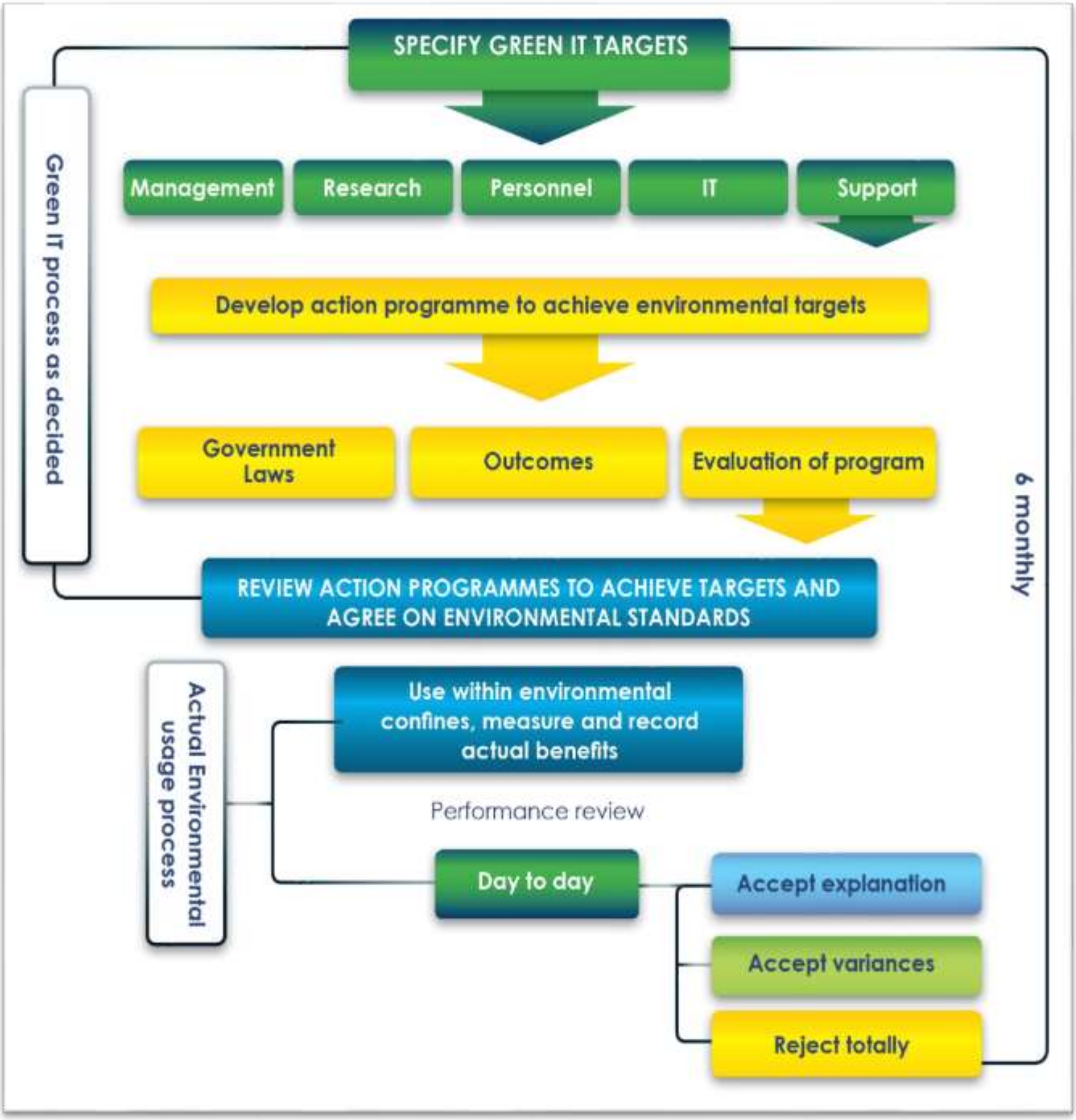

Figure 6.2 Process flow of Green IT implementation

Who are the users of the framework?

The intended user of the developed framework and process flow for Green IT implementation is IT professionals in various organisations. These IT professionals are responsible for the IT functions within their organisations. Their functions are of such a nature that they influence IT budgets to achieve environmental sustainability. As such, IT personnel have deep understanding of Green IT concept and environmental sustainability. Intrinsically, the IT personnel have rich knowledge, experience and competency to understand the frame work and process flow for Green IT implementation.

What is the unique problem addressed?

In general, frameworks and process flow for Green IT implementation are highly beneficial for IT personnel and managers. The development of Green frameworks and process flow for Green IT implementation provides a direction, illustrates evolutionary paths, and depicts necessary changes and practical application of Green IT implementation. In the same light, Green IT frameworks ensure that organisations respond to environmental sustainability in a proactive manner, prevent waste of resources and poor return on investment. In the ultimate, it provides effectiveness and success. Specifically, this framework addresses the lack of guidance for organisations about how to implement Green IT and leverage IT for environmental sustainability.

What are the framework's preconditions?

The framework and process flow for Green IT implementation is intended to be used in various organisations' working environment. This includes where organisations provide finance to IT department for activities that impact the natural environment. There are no restrictions to the framework's use in terms of level of education and environmental sustainability. Notably, the framework may require adaptions in order to be applicable to other organisational settings.

How should the framework be used?

The framework and process flow for Green IT implementation is for the use of IT professionals and managers. It is a tool for facilitating understanding and subsequent effective action relating to Green IT resulting in environmental sustainability. The framework allows IT personnel and management to focus attention on and allocate resources to Green IT for environmental sustainability within the organisations. The aim of the framework is achieved by exposing Green IT enabled management functions and moderating concepts, which are those aspects that critically affect the aforementioned environmental sustainability.

What are the framework's intended outcomes?

The intended outcomes of the framework are a positive effect of the organisations' environmental sustainability transformation, both with the organisations. In the same light, another outcome of the framework use is to create an awareness of where to focus management attention and resources to optimally affect the aforementioned sustainability transformation.

6.3 SUMMARY AND CONCLUSION

This chapter addressed the research problems, answered the research questions and achieved the research objectives by unveiling an empirical Green IT framework and operational process that should be used to support or guide Green IT implementation. This Green IT framework was developed in conjunction with the process flow for Green IT implementation. The process flow for Green IT implementation is intended to describe the sequential steps that should be followed to implement Green IT. Remarkably, it has been noted that some of the questions have led to further areas of research. These items are discussed in Chapter 7. Furthermore, a summary of the findings and recommendations are provided.

CHAPTER 7: CONCLUSION AND RECOMMENDATION

7.1 INTRODUCTION

This chapter discusses the summary of findings from the South African companies and provides recommendations. The organisations are conscientous about going green but they are not sure of how to go about it (Jenkin, Webster and McShane, 2010:17-34; Bose and Luo, 2011:3). This implies that many organisations are approaching management of IT in an unstructured manner through its life cycle (Steward, ND). The emergence of Green IT has increased interest in recent years as a nascent phenomenon which has become the catalyst. In particular, Green IT holds promise for addressing the broader environmental and health issues in organisations. Nevertheless, little research has been done to examine the potential of Green IT (Bose and Luo, 2011:1). It is no secret that the environmental movement has reached mass acceptance, as leading publications across the globe have put environmental issues on their covers in an effort to raise awareness. Therefore, the green movement has become a topic of conversation for environmentally friendly technologies to sustainable economic activity, through ensuring a secure energy supply, preservation and protection of the environment (Uddin and Rahman, 2012:4080-4084).

The importance of Green IT is now at the forefront of technological civilisation, therefore business and society do not have to become victims of their own opulence (Albertson, 2008). IT is part of the environmental problem, and it can be part of the solution. Green IT is an economic, as well as an environmental imperative. It is and will continue to be a necessity, not an option. Adopting Green IT practices offers businesses and individual's financial and other benefits because IT operations achieve better energy efficiency through green initiatives. IT is both a solution and a problem for environmental sustainability, and there is necessity to reverse the process of environmental degradation and move towards sustainable business practice (Murugesan, 2008:26-33; Murugesan, 2010:4).

This chapter comprises a summary of the findings of the study, limitations of the study, managerial guideliness for Green IT implementation, highlights future research opportunity in this field of study, contribution to the body of knowledge and conclusion.

7.2 SUMMARY OF FINDINGS

From the analysis of the interviews, a number of issues emerged with regard to factors that inhibit Green IT implementation.

7.2.1 Demographics

It is evident and undisputable that the IT personnel have the necessary knowledge, experience and competency. However, this study has revealed that they have limited knowledge of Green IT. As a result, this can possibly impede the acceleration of Green IT implementation within their organisations.

7.2.2 Ecological issues caused by IT use

In line with the findings, in Figure 4.3, it was quite interesting to note that some of the participants did not regard their companies as making efforts to protect the natural environment that is affected by IT operations. The author contends that from this perspective, there seems to be ignorance about the benefits that can be derived from Green IT. This means that the companies will continually contribute to the disproportionate burden of environmental degradation. Regrettably, in Figure 4.16, some of the participants indicated that their companies did not have any systems in place to minimise the impact caused by their IT activities. On the contrary, in the same Figure 4.16, some of the participants indicated that they don’t really need a system because their organisations are not causing any harm to the environment. The main argument is that if this situation is not addressed, IT operations will continue to harm the environment. Scientists provide a warning that climate change is carrying the risk of irreversible human wellbeing and development prospects across all countries. They believe that climate change is linked to greater hunger, species loss and homelessness caused by rising sea levels (Webster, 2014). Climate change is the most important environmental issue facing the world today because it poses a threat to human wellbeing and environmental integrity (Chowdhury, 2012:634). Therefore, action is required to halt the loss of biodiversity and tackle climate change for sustainable ecosystems and survivability of mankind (The Editors, 2009:1; Tomlinson, 2010:4). The debate about climate change is futile and action should be taken rather than to debate its existence (Webster, 2014). It has been thoroughly explored and is defendable by evidence that going green is connected with the sense of environmental awareness which is a concern for the ecosystem in which humans exist (Tomlinson, 2012:2). These ecological issues are making it increasingly urgent for organisations to pursue Green IT to tackle economic and environmental problems through a wide array of intervention methodologies and technologies (Carter, 2009; Zhang and Liang, 2012:997).

7.2.3 Energy consumption caused by IT equipment

The results identified in Figure 4.6 that some of the companies were not analysing their energy costs while others in Figure 4.9 indicated that their companies were not purchasing energy saving devices. Therefore, it is highly unlikely that Green IT will be successful without reducing energy consumption. If attempts are not made to reduce energy consumption, this situation will worsen, unless it is continuously evaluated and monitored.

In view of the findings on energy consumption, it was further discovered in Figure 4.25, that the participants were relying on paper copies hindering the success of going green because excessive printing hits on energy cost and further causes significant harm to the environment. Therefore, in Figure 4.18 printing reduction was suggested by participants because they derived some benefits from Green IT implementation, especially on energy cost.

The essence of Green IT is for organisations to maximise energy effeciency through efficient use of IT resources by correcting the accelarating rise of carbon emission (Chong et al., 2010:84; Sinha, 2011). The organisations should find alternative clean resources to improve energy effeciency through design and use of advanced technologies for environmental sustainability (Andreopoulou, 2012:1; Lee, Park and Trimi, 2013:630). In actual fact, reduction of energy consumption means purchasing less electricity (Nishant, Teo and Goh, 2012). The aftermath of Green IT adoption is that it will improve energy effeciency and lead to the reduction of pollution, eventually saving money (Talebi and Way, 2009; Valanju, 2008:26). The improvement of energy effeciency through lowering of GHG is the benefit of Green IT (Bandyopadhyay, 2008:1507).

7.2.4 Limited knowledge of green data centres

The study revealed in Figure 4.7, that the organisations are uncertain of the steps that they should take to green their data centres. Notably, in the same Figure the participants indicated that data centres were consuming a lot of energy and contributing to GHG as a result exacerbating environmental concerns. In view of this evidence, some of the participants indicated that their organisations were not taking steps to green their data centres. The participants were of the opinion that their companies were giving less attention to infrastructural issues that consume energy. It is believed by the participants from the evidence presented that the servers and data centres are hitting hard on energy even when they are idling.

In a nutshell, the study revealed that the organisations have limited knowledge of green data centres hence they outsource the management of data centres to external companies.

This means that the energy cost and environmental degradation will gradually continue to rise unless this situation is halted. It is therefore imperative that energy efficient technologies, data centres and servers should be effectively explored to meet green requirements.The data centres and servers contrinute to rapidly increasing annual GHG and exacerbate the environmental changes. In reality, energy consumption is connected to GHG emission and directly linked to climate change (Hanne,2011:425). Many data centres have become old and have reached their useful life. Consequently, they become hungry and ineffecient, using 2 to 3 times the energy for cooling (Uddin and Rahman, 2012:4083). In this regard, the evidence presented revealed that IT is placing a burden on electric grids and contributing to GHG that result in the future becoming grim (Murugesan, 2008:24). The point is that the process of climate change is irrevesible. As such, a number of studies indicate that IT industry carbon footprint is on the verge of exceeding the aviation industry because its rate of energy consumption is substantially increasing every year (Gartner, 2007; Carter-Steel and Tan, 2010:107; Siddiqui, 2013:411). A point of departure is for the companies to implement Green IT because it will help them to conserve the natural environment resources to achieve environmental sustainability.

7.2.5 Improper e-waste disposal

The study revealed in Figure 4.9, that the participants preferred to buy new IT equipment rather than increasing the life span beyond warranty. They also use an external company for disposal of their e-waste. On the contrary, the evidence revealed that the participants viewed the cost of repairs as being expensive and as a result, they are not upgrading and refurbishing their IT equipment to prolong their life span. The evidence from the study suggests that the organisations have limited knowledge on the disposal of obsolete electronic equipment. As a result, it is posing a challenge to their organisations. This clearly demonstrates lack of capacity to manage e-waste in the organisations.

Mounting scientific evidence revealed that the increase use of IT devices is making substantial contribution to the carbon footprints of organisations through its use, construction and disposal. Inadvertently, these increases of IT devices cause detrimental and irreversible impact on the environment (Campbell, Ratcliffe and Moore, 2013:127). The theory underpinning carbon footprint for organisations lies with its equipment because they have shorter life span (Chowdhury, 2012:639; Molla et al., 2008:671). In broader context, e-waste is the fastest growing problem globally because of the rapid accumulation of unused computers which have become part of the growing stream in landfills (Kiddee, Naidu and Wong, 2013:1237; Tocho and Waema, 2013:99). This scenario is exacerbated by inadequate legislation globally for effective e-waste management. In line with this statement, South Africa is not in isolation because the country does not have the capacity to manage e-waste (Hilty et al., 2006:30). Therefore, it is incumbent on the organisations to reduce, reuse and recycle IT used products in order to reduce the harmful effects on the environment and becoming ecologically responsible (Chung and Wee, 2010:466; Ramayah et al., 2013:247).

7.2.6 Incapacity to recycle

From the evidence presented in the study, the participants in Figure 4.9 indicated that recycling, refurbishing and repairs of computers in order to extend the life cycle of electronic products is playing a role in ensuring IT operations compliance. Surprisingly, some of the participants indicated that they were not recycling and their companies were lacking the capacity to manage e-waste. According to National Environmental Act (107 of 1998) Section 24, waste should be avoided, or where it cannot be avoided altogether it should be minimised, reused or recycled. In view of the statement above, many organisations do not have convenient access to recycling. As a result, e-waste recycling leaves many unresolved questions related to human exposure to toxins during recycling (Gaidajis, Angelakoglou and Aktsoglou, 2010:197). Understanding the implications of human exposure to toxins during recycling, e-waste should be recycled and managed in caution because of its inherent risks (Kahhat and Williams, 2009). From a bird's eye point of view, there is a little formal governance over e-waste and recycling thereby exacerbating the recycling challenges (Hogan, 2011:9-10).

7.2.7 Lack of e-waste legislations (Policies/Regulations)

The study revealed in Figure 4.14, that some of the participants were uncertain about the policies and regulations to mitigate the harmful impact that is caused by IT use. In the same light, the participants indicated that there was lack of formal penalty and the regulations were not enforceable to ensure handling and safe disposal of e-waste. The evidence presented by this study suggests poor legislation on e-waste to protect the environment and improve the quality of life. In the same wavelength, in Figure 4.14, the participants were of the view that there was lack of awareness among staff members because policies and regulations were not publicly available. Surprisingly, the participants revealed that they were not ensuring compliance because there was insufficient legislation dealing with e-waste. They also revealed that government policies were inadequate and being reactive rather than proactive. It should be noted that the purpose of the legislation is to provide a governing framework to protect the environment and hold organisations accountable. This evidence is classic demonstration that there is lack of policies/regulations within the organisations. This lack of policies/regulations has resulted in unsatisfactory e-waste disposal because of poor regulatory controls (Couth and Trois, ND:16). In particular, there is lack of developed policies that regulate the handling, discarding of hazardous waste (Holmner and Marais, 2013:136). As a result of lack of legislation, carbon emission remains unregulated and e-waste is growing at unprecedented rate causing significance impact on the environment (Hanne, 2011:425). It is important for organisations to comply with environmental regulations to create hope of reaching environmental sustainability. Green IT enables organisations to prepare for future legislations and regulations that will benefit the organisations, employees and the environment (Chou, 2013:231-235; Uddin and Rahman, 2012:4082). It is for this reason that the organisations are developing interest in carbon footprint that can be found in green regulations formulated by environmental agencies (Sinha, 2011). Unfortunately, South Africa does not have a dedicated legislation dealing with e-waste like other countries. Therefore, the country needs to respond to emerging issues of e-waste by developing new regulations (The Advanced Tropical Environment, 2012:14).

7.2.8 Lack of IT Policy impeding Green IT implementation

The study in Figure 4.18 revealed that the companies do not have IT policies in order to promote energy savings. In theory, it should be noted that IT policy is beneficial for the company to protect it from external threats. In light of the above statement, the present evidence indicates that Green IT implementation is hindered.

The rising cost of energy and environmental awareness have introduced challenges for organisations globally, prompting for searches for efficiency and cost reduction caused by IT (Chawla, 2013:3). In the same light, there is strong evidence that suggests that Green IT has the potential to reduce energy usage and bills (Chou, 2013:236; Trimi and Park, 2013:364). Research studies revealed that environmental stewardship has emerged over the years to reduce GHG and carbon foot print that eventually results in climate change. As a result, organisations are playing a major role in the protection of the environment by implementing policies to improve their business performance (Brooks, Wang and Sarker, 2012:16). In a sense, organisations are aware and interested in the economic, strategic, regulatory, environmental and social concerns related to the use of IT for sustainable and responsible business (Sarkar and Young, 2009). Therefore, they have accepted and acknowledged their responsibilities in protecting the environment and contribute to a sustainable environment, thus becoming eco-friendly in order to thrive (Berthon et al, 2010:14; Molla and Abareshi, 2012:93).

7.2.9 Unstructured and uncoordinated Green IT implementation

The evidence provided by the study in Figure 4.17 revealed that the participants believe in Green IT as an investment for their companies. However, quite shockingly the participants mentioned that their organisations were not focusing on green or energy savings. They highlighted that their purchasing does not take into consideration the green aspects. In light of this finding, a further blow was that some of the participants indicated that their companies were not going green because they did not derive any value from Green IT adoption.

Furthermore, the evidence in Figure 4.19 showed that there are no factors that are driving Green IT adoption. This clearly indicates that there is limited understanding of Green IT. On the other hand, some organisations indicated that because their suppliers were green, it automatically meant they were going green as well, while others mentioned that their organisations were not purchasing energy saving devices. Again, in Figure 4.9 the participants pointed out that their organisations were not considering IT product life cycle when procuring computers. This is a classic illustration that there is lack of knowledge for Green IT implementation. The evidence presented by the study suggests that the companies are applying or implementing Green IT in an unstructured manner because they don’t have a defined strategy. In view of the literature, the organisations have been found to be conscientious about being green. In context, IT is playing a leading role in the fight against climate change, which has the potential to reduce annual global emission as a threat of climate crisis that is real, imminent and universal (Chowdhury, 2012:639; Molla et al., 2008:671). However, it has been found that the organisations are uncertain about how to implement Green IT (Jenkin, Webster and McShane, 2010:17-34; Bose and Luo, 2011:3).

7.2.10 Lack of defined Green IT strategy and poor vendor management

It was interesting to note in Figure 4.20, that the participants revealed that there is no strategy in the organisation to drive growing computing needs. Remarkably, in Figure 4.25, some of the participants revealed that their companies were not conducting research before purchasing. Similarly, in Table 4.1, some of the participants were of the view that Green IT strategy did match their business requirements. A clear picture from the results designates that there is lack of strategy and poor vendor management. It is imperative for all organisations to implement Green IT, and have green visions and strategic plans that are based on long term objectives for business to gain competitive advantage through the reduction of IT operational cost leading to environmental sustainability (Campbell, Ratcliffe and Moore, 2013:132).

7.2.11 Limited knowledge of IT personnel

It was interesting to note that some of the participants in Figure 4.22 pointed out that their IT operations did not contribute to environmental harm. They regarded their companies as making efforts in ensuring reduction or elimination of sensitive materials resulting from IT products that influence the environment by utilising various methods of technology. Shockingly, some of the participants in Figure 4.22 were of the opinion that their companies had limited knowledge on Green IT implementation. The present evidence indicates that the IT personnel have limited knowledge of Green IT. Fundamentally, little research has been done to examine the potential of Green IT. Therefore, the time has come for the organisations to refocus their resources on finding solutions that will reduce or eliminate carbon emissions (Roosa and Jhaveri, 2009). A holistic and comprehensive strategy should be developed by these organisations to minimise the impact of the ecosystem (Cai, Chen and Bose, 2013:493). This strategy should be aligned with the business strategy to enhance organisational competitiveness and manage the environmental aspects (Erek, 2011:2; Olson, 2008:22).

7.2.12 Limited involvement of employees on Green IT implementation

The participants in Figure 4.22 mentioned that their companies involved them in making Green IT part of their culture. In contrast, some of them revealed that their companies were not involving them in Green IT implementation. The study also revealed that employees were not adequately involved in Green IT implementation. It is important to engage stakeholders in finding ways to significantly slow the onslaught of climate change which is an important task for the organisations, government and decision makers around the world (Roosa and Jhaveri, 2009). In particular, green strategy can be developed by engaging stakeholders, conducting audit and review of equipment purchases, disposal policies and practices, reducing carbon foot print, energising the workforce and monitoring and outlining tangible and intangible benefits, then revising the strategy (Bose and Luo, 2011:242; Chou, 2013:236; Molla and Abareshi, 2012:93).

7.2.13 Inadequate training of employees and managers on Green IT

The study revealed in Figure 4.25 that the staff were not adapting to their work habits without supervision because they were inadequately trained. In the same way, the participants in Figure 4.15 indicated that they were not provided with training on policies and procedures. Therefore, this is collapsing their Green IT strategy. The evidence presented indicates that there is lack of training regarding Green IT.

The evidence presented in Figure 4.6 acknowledged that employees and managers were not adequately receiving appropriate training regarding the measures that should be instituted to reduce/minimise energy consumption that is caused by IT operation. The success of Green IT depends on how well the employees perform. Without training the organisations will not be able to attain their goals in improving energy efficiency. Lack of personnel skills development unfavourably impacts the company success for Green IT implementation.

7.2.14 Too much outsourcing of IT operations

The study revealed in Figure 4.7 that some of the organisations were outsourcing some of their activities to external companies in order to reduce the cost of doing business and focus on their core business. However, some were discontented that too much outsourcing was impeding Green IT strategy and posing a challenge to their organisations because they did not have proper control. This indicates that outsourcing has potential benefits and challenges for the organisations. The truth is that it is important to develop an overall strategy that identifies opportunities for greater efficiency that the organisations would benefit from the new technology, which would improve processes that may be difficult to achieve in Green IT value (Hodges, 2004). In general, the strategy for green lies at the heart of good economic policy portrayed as a means to alleviate poverty (Borel-Saladin and Turok, 2013:212).

7.3 LIMITATIONS OF THE STUDY

The following have been identified as limitations to the research study:

- This study has been limited to eight South African companies and focused on IT personnel, which may limit the generalisation of the findings.

- The research focused only on the companies that were based in Gauteng, Free State and North West Provinces. However, the outcomes may differ in other provinces.
- The lack of researcher access to participants conveyed some restraints because participants who were involved in the study could not be easily traced.
- In-depth interviews are time consuming and expensive compared to other data collection methods, especially good interviews are hard to write and they take a considerable time to develop and process
- The research sample is little. Therefore, it cannot represent the exact population from which it is drawn. Ultimately, it becomes difficult to generalise the results. The success of judgement sampling is solely dependent on a thorough knowledge of the population and elimination of the use of inferential parametric statistical tools for the purpose of generalisation.
- The data interpretation for this research was not easy.
- The research approach did not eliminate differences of opinions.
- The participants did not answer all the questions.
- The approach of this research relied heavily on the knowledge of the IT personnel. The study emphasised the business aspects rather than the technical aspects of Green IT.
- There is uncontrolled variability and bias in the estimates in judgement sampling. Interviews may seem intrusive to the participants and they are also susceptible to interview bias.

7.4 RECOMMENDATIONS

For the results of this study, the following guidelines are given to the organisations in order to ensure that they reap the benefits of Green IT implementation in the future:

7.4.1 Ecological issues

The following recommendations are made to ensure that ecological issues are properly addressed:

- Green products that are certified should be purchased to enhance a sense of environmental awareness and economic development. Environmentally friendly goods that meet stringent energy efficiency standard such as EPEAT are less harmful to human health and environment.
- IM Communication such as teleconference, Skype, Lync or videoconference call should be utilised to reduce travelling. This will allow people working far away from each other to interact. This type of communication allows paperless communication as well and it will reduce carbon emission caused by vehicles leading to environmental pollution. Therefore, employees should be encouraged to utilise this type of technology.
- Printing should be reduced because it causes significant environmental harm due to the cutting of trees to manufacture printing paper. Therefore, double sided print out should be implemented and the organisations should consider going digital. This has the potential to reduce the energy costs by 30%. Also, the printing configurations should be changed to use less paper and ink.
- Electronic equipments should be disposed of safely because they contain hazardous material such as dioxins, polychlorinated biphenyls, cadmium, chromium, radioactive isotopes, mercury and lead that does not belong to the landfills.
- Environmental laws should be complied with to address environmental pollution that is caused by IT use.
- Utilise ISO 14001 standard and Environmental standards because they are practical tools for companies to manage their environmental responsibilities. Use suppliers that are ISO 14001 certified.
- Outsource data centre management to experts that will provide solution to solve pressing data management issues.

7.4.2 Energy consumption

The following recommendations are made by the study to reduce energy cost by IT products:

- Use natural resource to reduce energy consumption and pollution to the atmosphere.
- Energy cost should be analysed to determine the usage of energy by IT equipments in order to reduce energy costs.

- Audit energy consumption in order to provide the organisation with accurate information on how they can reduce energy consumption and save energy costs. This will translate to financial savings of about millions of rands for the organisations.
- Procure energy efficient products to reduce energy loads, increase cost effectiveness and resource conservation. Procured products should meet Energy Star criteria. This has the likelihood of reducing the energy consumption cost by 30% thereby increasing the organisation bottom line and providing value for the business.
- Computer power that is on all the time can shorten its life span. Therefore, manually switching off computers from the plug is recommended to promote energy savings. This is likely to reduce energy consumption by 30%.
- The use of bio plugs can help the organisations to reduce energy bills and eventually saving energy.
- Promote training and awareness on energy efficiency to encourage energy savings. Training is the most effective way of ensuring successful Green IT implementation.
- Switch from a paper based to electronic workflow by creating, viewing and delivering documents in digital rather than printed form. Also, send documents through email attachments rather than faxing.
- Install printer usage monitoring.
- Use fluorescent light bulbs to save on energy costs.
- Use environmentally friendly products to reduce or minimise harm to the ecosystem.
- Conform to international environmental standards because they regulate human activity upon the environment.

7.4.3 Limited knowledge to green data centres

The following recommendations are made by the study to reduce the energy cost by data centres:

- Energy cost should be analysed to determine the usage of energy by data centres in order to reduce the cost of energy.
- Green the data centres to maximise their energy efficiency and minimise their environmental impact.
- Attention should be given to infrastructure to facilitate, manage and enable efficient data centres.

- Increase the temperature of data centres without putting them in jeopardy of overheating to cut on energy costs.
- Ensure that the server rooms and data centres are energy efficient and the cooling systems are running at maximum efficiency.
- Use server virtualisation to allow one physical server to be used into a multiple isolated virtual environment to reduce energy consumption.
- Servers should be centralised to connect to a central server which will act as agent for all communications.
- Install sensors to measure the energy that servers, storage, networking and cooling equipment use. This will provide a baseline to determine if the data centres are efficient.
- Outsource data management to expert companies to help in the management of data centres.
- Consider using cloud computing to remote server's hosted environment rather than using local servers.

7.4.4 Ineffective e-waste management

The following recommendations are made to ensure effective waste management:

- Green product should be purchased to enhance a sense of environmental awareness and economic development because environmentally friendly goods are less harmful to human health and environment.
- Consider IT product life cycle upfront because understanding the IT life stages helps to get the longest possible life span out of a product and the organisation can receive return on investment.
- Focus on buying pieces of IT equipment with good quality and that are reliable to reduce on the frequency of e-waste.
- Upgrade hardwares and softwares to extend the life span of computers and enhance computer version.
- Reuse and recycle IT electronics ensuring separation at the source, reducing e-waste. This is the most effective method to manage e-waste.
- Repair and upgrade pieces of IT equipment to increase their life span.
- Segregate e-waste before disposal for proper disposal and recycling.
- Return obsolete IT equipment to the supplier to ensure safe disposal.

- E-waste should be reduced and disposed of safely to eliminate hazardous material at licenced dumping sites.

7.4.5 Incapacity to recycle

The following recommendations are made by the study to ensure that recycling is conducted in a proper manner:

Ensure that recycling of electronic devices is conducted to reduce e-waste. Obsolete computers and electronics are valuable sources for secondary raw materials if recycled; otherwise these devices are a source of toxins and carcinogen.

7.4.6 Fragmented and ineffective policies and regulations

The following recommendations are made by the study to ensure that effective policies and regulations are implemented:

- Efforts should be made to ensure regulatory compliance with the policies and regulations due to poor regulatory controls. The available policies and regulations should be enforced.
- Organisations should partner with governmental stakeholders to pursue the development of sufficient legislation on e-waste to protect the environment.
- Internal and external audits should be conducted to improve the organisations' IT operations and ensuring compliance with environmental laws.
- ISO 14001 management system should be implemented to ensure compliance with standards monitoring and reporting tangible improvement in sustainable use of natural resources.

7.4.7 Lack of IT Policy

The following recommendation is made to ensure that IT policy is developed and administered:

- Adopt green policies and conform to the rules and regulations to ensure the promotion of green concept. IT policy plays an important role in technology innovation being implemented.
- Develop IT policy to guide the employees and ensure environmental protection and security of networks and information resources. IT policy is crucial in the successful implementation of Green IT.

- Ensure IT policy is administered in the most efficient and effective manner. The policy should include the prevention, reduction and control of pollution of any of IT use causing harm to the environment.

7.4.8 Unstructured and uncoordinated green IT implementation

The following is recommended by the study to ensure that Green IT implementation is coordinated in a structured way:

- Green IT should be approached by purchasing green products that are certified and energy efficient during their life time and recyclable. Utilise the Green IT framework and process flow for the approach.
- Competency of IT personnel should be developed through the attendance of workshops, symposia, seminars and conferences. The relative lack of IT personnel competency will lead to trial and error approach in Green IT implementation.

7.4.9 Poor vendor management

The following recommendations are made to ensure effective vendor management:

- A clear detailed action plan should be developed by suppliers to address environmental problems caused by IT use by assigning responsibilities, allocating resources, monitoring and regulating actions and measuring evaluation of outcomes.
- Conduct research to identify IT business needs. This will ensure that Green IT strategy is implemented in a structured manner.
- Match IT system to business requirements for the successful implementation of Green IT. Formulate the requirements to ensure that the supplier provides useful IT related materials to the organisation.
- Provide sufficient IT budget to acquire green technology systems that are environmentally friendly. This will ensure the successful implementation of Green IT.
- Management support is required for the successful implementation of Green IT strategy. Management has influence on the success of the Green IT strategy.
- Obtain a supplier with good technical support to solve specific IT problems and provide assistance to accelerate the Green IT process.
- Procure from a cost effective supplier to ensure affordability of the Green IT process.
- Look for Energy Star and EPEAT ratings when selecting a vendor.

- Ensure that the supply chain do business with suppliers that make effort to minimise GHG emissions.
- Ensure proper vendor management to ensure that relationships exist to ensure that agreements are mutually beneficial for both parties. Select a vendor that will match the company performance. Impose green requirements on the supplier and demand sustainability report.
- Develop Green IT strategy to meet the operational requirements for function ability of IT and environmental protection.

7.4.10 Limited knowledge of IT personnel

The following recommendations are made to develop the capacity of IT personnel:

- Develop capacity of IT personnel by ensuring that they attend workshops, seminars, symposia and conferences that are related to Green IT to keep abreast with the latest developments and expand their knowledge. Increased knowledge of personnel is likely to enhance their expertise in Green IT implementation.
- Teach IT professionals and employees to effectively utilize modern technology. Green IT implementation will be effective if the recipients are ready to embrace it.

7.4.11 Inadequate involvement of employees

The following recommendations are made by the study to ensure participation of employees in Green IT implementation:

- Involve/engage stakeholders in order to contribute to the effective and informed decision making of Green IT implementation. Inadequate involvement of employees will create a barrier for successful Green IT implementation. In this regard, employee involvement will ensure that the objectives of Green IT are fulfilled.
- Increase participation of employees in environmental management to maintain and improve quality of life. Failure to ensure participation of employees is likely to hamper the success of Green IT implementation.
- Disseminating meaningful information about Green IT through awareness campaigns ensures better understanding of Green IT concept for successful implementation. This will create a platform of sharing experiences and gaining a better understanding of the Green IT concept.

7.4.12 Lack of training of employees

The following recommendations are made by the study to enhance the knowledge of employees on Green IT implementation:

- Train employees and managers on Green IT strategy to improve and enhance knowledge of Green IT concept. The lack of training and awareness will result in employees not supporting Green IT and implementation of new technologies. Therefore, training will contribute to the successful implementation of Green IT.
- Train staff on environmental impact that is caused by IT use to improve and enhance knowledge of employees on environmental issues that are caused by IT use. Training is important for any organisation that desires to incorporate any change.
- Create an awareness and understanding of environmental issues to employees. This will ensure that employees contribute significantly to the protection of the environment from harm caused by IT use.

7.4.13 Too much outsourcing

The following recommendation is made by the study to ensure that Green IT is properly implemented:

Reduce outsourcing of many IT activities to ensure proper control. Outsourcing is a threat to security and confidentiality. It is also associated with weak management, inexperienced staff, business uncertainty, outdated technology skills, hidden costs and loss of control because it is tied to the wellbeing of another company, lack of organisational learning and loss of innovative capacity.

7.5 AREAS OF FUTURE RESEARCH

This study contributes various opportunities for further research, notably:

- Examine the proposed Green IT framework in a new context, location or culture. The outcomes of the Green IT framework may differ in other locations.
- Analyse the global comprehensive data to determine the magnitude of e-waste problem in different countries. This has been identified as an obstacle to addressing e-waste in South Africa.

- Explore the design of a methodology to green data centres for reducing energy consumption. This is to ensure that data centres become more energy efficient.
- Compare traditional data centres with data centres using cloud technologies and determine their efficiency. This is to determine the most efficient alternative technology.
- Explore the effective management of e-waste in both developed and developing countries. This is to ensure that IT equipments are disposed of in an environmentally sound manner and ensuring compliance with environmental laws.
- Explore the methodology that is used by suppliers and manufacturers to dispose of e-waste. This is to determine if the suppliers and manufacturers are properly utilising the appropriate technology in disposing of e-waste.
- Determine how green economy can impact Green IT strategy, structure and culture of today's organisations. This is to ensure that organisations gain financial growth and moral revival. Limited research exists on this subject.
- Explore the measures that should be taken to address GHG emissions. This is to ensure that measures are developed to reduce GHG emissions.
- Determine if IT should continue to evolve naturally within business or it should be an active enabler of change for the organisations to drive down emissions and reduce the environmental impacts of business operations. This is to ensure that IT becomes the enabler for curbing emissions and environmental impact.
- Explore the benefits of driving IT for business innovation. There is limited research on this topic.
- Explore preventative measures of ecological change to avert catastrophic climate change. This is to ensure that IT becomes the enabler for environmental sustainability.
- Explore and evaluate recycling methods that are most beneficial for preventing adverse health effects. This is to ensure that recycling is properly conducted to prevent potential health and environmental risks.
- Explore how the organisations can achieve green economy. This is to provide guidance and approach on how to move towards green economy.
- Explore the development of a model for Green IT. This is to ensure that the framework is tested and a model is developed out of the tested framework.

7.6 CONTRIBUTION TO THE BODY OF KNOWLEDGE

The research study has made contribution to the body of knowledge that has not been made before which is based on the primary data collected from the South African companies. The study has unveiled and filled the growing gap of Green IT implementation within the South African organisations by developing a new chain of thought. This was done through the development of Green IT framework and process flow of Green IT implementation that can be incorporated by organisations in their strategic business plan. The researcher developed this Framework using qualitative research approach. The approach of this framework will provide business with enormous benefits such as reduction on energy and business cost that will translate into financial returns, environmental protection, human health and wellbeing protection and ensuring corporate social responsibility.

7.7 SUMMARY AND CONCLUSION

This chapter provides the summary of the findings of the study, limitations of this study, recommendations to South African organisations, areas of future research and contribution to the body of knowledge. The impact of Green IT implementation in creating a sustainable environment is presently unknown. Therefore, a flexible, dynamic and secure Green IT framework is required to deal with unprecedented increases of energy and reduce carbon footprint to impact economies, health and resources (Uddin and Rahman, 2012:4079-4080). Research studies revealed that the most common reason for organisations to pursue Green IT is the benefit it derived that includes the reduction in power consumption cost, low carbon emission and reduced environmental impact (Bose and Luo, 2011:39, Siddiqui, 2013:410; Yunus et al., 2013:241-242).

It has been thoroughly explored and defendable by evidence that Green IT is at the forefront of technological civilisation. Therefore, business and society do not have to become victims of their own opulence (Albertson, 2008). The findings of this study have addressed the research problem by achieving the research objectives of developing Green IT framework for South African organisations. The study highlighted some other issues in the ongoing debate regarding the pros and cons of Green IT implementation.

After an extensive research for this study, a research gap was identified on ecological issues, lack of training on policies and regulations, unstructured and uncoordinated green IT implementation, limited knowledge to green data centres, too much outsourcing, incapacity to recycle, improper e-waste disposal, lack of e-waste legislations, limited knowledge of IT personnel, inadequate involvement of employees and poor vendor management have been identified as factors that are impeding the implementation of Green IT. The study has addressed these research problems by developing a Green IT framework that explicates the enabling capability of Green IT for environmental sustainability.

It is important to note that Green IT is economic, as well as an environmentally imperative. This means, it will continue to be a necessity, not an option. Therefore, adopting Green IT practices offers businesses and individuals financial and other benefits. Given the rise in public concern for the state of the environment, IT operations can achieve better energy efficiency through green initiatives. Therefore, it is seen as part of the problem and part of the solution (Murugesan, 2008:26-33).

The proposed new Green IT framework in this study will provide an imminent solution for IT personnel and organisations. As a result, the organisations will reap the benefits of Green IT implementation. IT solutions can help the companies to reduce on their GHG emissions so that climate change can be eliminated or reduced.

REFERENCES

14th Annual IEEE/ACM international symposium in cluster, cloud, and grid computing. (2014). Retrieved on 12 February 2014, from http://www.wikicfp.com/cfp/servlet/event.showcfp?eventid=29893&copyownerid=4933.

Adams, K.A., and Lawrence. E.K. 2015. *Research Methods, Statistics, and Applications*. Los Angeles: Sage.

Adhikary, R. 2008. The Promise of Green Design. *Design Management Review*, FALL 2008, 22-29.

Advanced Tropical Environment (ATE). 2012. Identification of the Magnitude of the Electrical and Electronic (E-Waste) situation in South Africa: A Strategic Approach to International Chemical Management (SAICM) E-waste as an Emerging Policy Issue. Department of Environmental Affairs, Pretoria: South Africa.

Albertson, S.E. 2008. Reducing the Environmental Footprint of Personal Computers and Datacentres. (Doctoral dissertation,University of Maryland University College). Maryland in Europe May.

Andreopolou, Z.S. 2012. Green Informatics: ICT for Green and Sustainability. *Agricultural Informatics, 3(2), 1-8.*

An Enterprise Management Associates (EMA). 2008. Going Green: A Strategic Guide to Green IT Management. *IT Management Research, Industry Analysis and Consulting*. White paper prepared for CA.

Avvannavar, S.M and Shrihari, S. 2007. E-waste Management. *Environmental Engineering and Management Journal, 6(4), 309-312.*

Atkinson, G., Hamilton, K., Ruta, G., and Van der Mensbrugghe, D. 2010. Trade in Virtual Carbon: Empirical Results and Implications for Policy. *The World Bank Development Economics. Policy Research Working Paper No. 5194, 1-28.*

Babbie, E., and Mouton, J. 2011. *The Practice of social research*. Cape Town: Oxford University Press.

Babbie, E., and Mouton, J. 2007. *The practice of social research*. Cape Town: Oxford University Press.

Badenhorst, M. 2009. Making Sense of IT Governance: The Implications of King III Paper for CIS Corporate Governance Conference on 10 to 11 September 2009. Cape Peninsula University of Technology: South Africa.

Bailey, D. 1987. *Methods of social research. United State of America*: New York. The Free Press.

Bandyopadhyay, A. 2008. Indian Initiatives on E-Waste Management – A critical Review. *Environmental Engineering Science, 25(10) 1507-1526.*

Basel Convention on the Control of Transboundary Movement of Hazardous Waste and their disposal. 1989. Available at http://www.basel.int/text/con-e.pdf

Bate, R. 2005. Freedom Reduces Per Capita Greenhouse Gas Emissions. *Institute of Economic Affairs. 25, 58-58, March 2005.*

Bates, M., Pillips, P., and Mbeng, L. 2008. Key recommendations for waste management policy decision-makers : A case study of future opportunities for non-municipal waste facilities in Northamtonshire. London. *Resource Conservation and Recycling.*

Berghout, E., Nijlan, M., and Powell, P. 2011. Management of life cycle costs and benefits: Lessons from information System practice. *Computer in industry Asian Journal of Psychiatry, 1-10.*

Begum, K.J.A. 2013. Electronic Waste (E-Waste) Management in India: A Review. *IOSR Journal of Humanities and Social Sciences, 10(4):46-47.*

Beluz, J., Plumer, B., and Resnick, B. 2016. The 7 biggest problem facing science, according to 270 scientists. Retrieved on 22 May 2015, from https://www.vox.com/2016/7/14/12016710/science-challeges-research-funding-peer-review-process

Berghout, E., Nijlan., M and Powell, P. 2011. Management of life cycle costs and benefits: Lessons from information System practice. *Computer in industry Asian Journal of Psychiatry, 62, 755-764.*

Berthon, P., Crittenden, V., Desautels, P. and Pitt, L. 2010. Get the most of Green IT. *Institute of Industrial Engineers, 52(5),14-18.*

Billinghurst, B.M. 2005. E-waste: A Comparative Analysis of Current and Contemplated Management Efforts by the European Union and the United States. *Colo. Journal of International Environmental L and Policy, 16(2), 399-427.*

Binns, S., Kretzmanb, E., Kurpiewski, M., S, Lee., Carlson, S., Marke, A., Reilly, C., Senefelder, S., Wade, S., Wilson, S., and Cohen, S. 2006. "Electronic Waste Recycling Promotion and Consumer Protection Act" [online], Available: http://www.columbia.edu/cu/mpaenvironment/pages/projects/summer06/ewastefinalReport.pdf [Accessed 24 March 2015], The Workshop in Applied Earth Systems Management I, Columbia University, 18 August 2006. [11] EMPA, "Hazardous".

Bless, C., Higson-Smith, C., and Kagee, A. 2006. *Fundamentals of Social Research Methods an African Perspective.* 4th Edition. Cape Town: Juta & Co Ltd, 40-45.

Boccaletti, G., Loffler, M., and Oppenheim, J.M. 2008. How IT can Cut Carbon Emissions. [Available on line at http://www.mckinsey.com/How IT can cut carbon emission 2221].

Boiral, O. 2006. Global Warming: Should Companies Adopt a Proactive Strategy? *Long Range Planning,39(1),315-330.*

Borel-Saladin, J.M., and Turok, I.V. 2013. The Green Economy: Incremental Change or Transformation*? Environmental Policy and Governance, 23, 209-220.*

Borggren, C., Moberg, A., Rasanen, M., and Finnveden, G. 2013. Business Meeting at a distance – Decreasing Greenhouse Gas Emissions and Cumulative energy demand? *Journal of Cleaner Production, 41: 126-139.*

Bose, R., and Luo, X. 2011. Integrative framework for assessing firms' potential to undertake Green IT initiatives via virtualisation – A theoretical perspective. *Journal of Strategic Information Systems, 20(1) 38-54.*

Botes, A. 2012. SA'S Total Carbon Emissions. Urban Earth Newsletter. Retrieved on the 04 April 2018, from https://www.brighthub.com/environment/green-computing/articles/71176.aspx

Bourke, B. 2014. Positionality: Reflecting on the Research Process. *The Qualitative Report, 19*(33*), 1-9.*

Brahma, S. S. 2009. Assessment of construct validity in management research. *Journal of Management Research*, 9(2*), 59-71*.

Brooks, S., Wang, X., and Sarker, S. 2012. Unpacking Green IS: A Review of the Existing Literature and Directions for the Future. *In Green Process Management. 15-37.*

Brynard, P.A., and Hannekom,S. X. 1997. *Introduction to research in Public Administration and related academic disciplines*. Pretoria: J.L. Van Schaik.

Brynard, P.A., and Hanekom, S.X. 2006. *Introduction to Research in management –related fields*. , 2nd edition. Pretoria: Van Schaik publishers.

Buckby, S. 2008. Board review of IT governance in Australian Universities. Unpublished doctoral dissertation. Queensland University of Technology. Queensland: Australia.

Butler, T. 2010. Compliance with Institutional Imperatives on Environmental Sustainability: Building theory on the role of Green IS. *Journal of Strategic Information Systems, 20(1) 6-26.*

Cai, S., Chen, X., and Bose, I. 2013. Exploring the Role of IT for Environmental Sustainability in China: An empirical analysis. *International Journal Production Economics, 146: 491-500.*

Cairns, C.N. 2005. E-waste and the Consumer: Improving Options to Reduce, Reuse and Recycle. Proceedings of International Symposium on Electronics and Environment, New Orleans, United States.

Cameron, K.W. 2009. My IT carbon footprint. *IEEE Computer Society.November 2009, 42, 99-10.*

Campbell,W.M., Ratcliffe, M., and Moore, P. 2013. An Exploration of the Impact of Organisational Culture on the Adoption of Green IT. *IEEE InternationalConference on Green Computing and Communications and IEEE Internet of Things and IEEE Cyber, Physical and Social Computing, 126-133.*

Canadian International Development Agency. Report on Plans and Priorities. 2010. Retrieved on 22 May 2015, from https://www.tbs-sct.gc.ca/rpp/2009-2010/inst/ida/ida-eng.pdf

Cater-Steel, A, and Tan, W. 2010. The Role of IT Service Management in Green IT. *Australian Journal of Information Systems, 17(1), 107- 125.*

Chakravarthy, V.J., Kumar, P. H., and Ragav, R. 2013. Green Computing – Towards Green Future. *IJREAT International Journal of Research in Engineering and Advanced Technology, 1(1), 1-6.*

Charnovitz, S. 2012. Organising for the Green Economy: What an International Green Economy Organisation Could Add. *The Journal of Environment and Development, 21(1), 44-47.*

Chaudhuri, S, Kumar, R, Joshi, M, Terrell, E, Higgs, F, Aleven, V and Rose, C.R. 2008. Its not easy being Green: Supporting Collaborative Green Design Learning. In Proceedings of Intelligent Tutoring Systems. Mellon University, Pittsburgh: Pennysylvania.
Chawla, N. 2013. Cloud Computing: A Green IT Initiative. *ASM's International E-Journal of Ongoing Research in Management and IT, 1- 9.*

Chen, J.W., Boudreau, M., Watson, R. 2008. Information systems and ecological sustainability. *Journal of Systems and Information Technology, 10(3), 186-201.*

Chibunna, J.B., Siwar, C., Begum, R.A and Mohamed, A.H. 2009. *Awareness towards E-Waste Management - A case study of UKM Malaysia* .University Kebangsaan: Malaysia.

Childs, S. 2008. Green Computing. *Heath Information on the Internet*, 62(1), 1-2.

Chou, T.Y., Ng, W.T., Gu, Q., and Ng, W.K. 2010. A Study of Green IT Strategies for Going Green Organisations. Annual International Conference on Green Information Technology (Green IT 2010).

Chou, D. C. 2013. Risk Identification in Green IT Practice. *Computer Standards and Interfaces, 35: 231-237.*

Chou, D.C., and Chou, A. Y. 2012. Awareness of Green IT and its value model. *Computer standards and interfaces, 34(1), 447-451.*

Chow, W.S., and Chen, Y., 2009. Intended Belief and Actual Behaviour in Green Computing in Hong Kong. *Journal of Computer Information Systems, 50(2),136-141.*

Chowdhury, G. 2012. Building Environmentally Sustainable Information Services: A Green IS Research Agenda. *Journal of the American Society for Information Science and Technology, 63(4), 633-647.*

Christensen, L. B., Johnson, R. B. & Turner, L.A., (11th Ed.) 2011. *Research Methods, Designs and Analysis*. Boston-USA: Pearson.

Christy, J.R., Norris, W.B, and McNider, R.T. 2009. Surface Temperature Variations in East Africa and Possible Causes. J. Climate 22. Retrieved on 23 May 2015, from http://journals.ametsoc.org/doi/full/10.1175/2008JCLI2726.1

Chuang, S., and Huang, S. 2015. Effects of Business Greening and Green IT Capital on Business Competitiveness. *Journal of Business Ethics*. *128, 221-231*.

Chung, C., and Wee, H. 2010. Green-product design value and information technology investment on replenishment model with remanufacturing. *International Journal of Computer Intergrated Manufacturing, 23(5), 466-485.*

Churchill, G.A. 1979. A paradigm for developing better measures of marketing constructs. *Journal of Marketing Research, 16, 64-73.*

Clarke, A. (4th Ed.) 2011. *An Invitation to Social Research: How it's Done.* New York: Wadsworth Cengage Learning.

Clarke, K . 2009. Green Computing Trends You should Know. *Association Now, 5(8), 19.*

Collis, J., & Hussey, R. (2003). *Business Research: A Practical Guide for Undergraduate and Postgraduate Students* (Second Ed.) Hampshire, United Kingdom: Palgrave Macmillan.

Coyne, I. T. 1997. Sampling in Qualitative Research. Purposeful and Theoretical Sampling: Merging or Clear Boundaries *? Journal for Advanced Nursing,* 26, 623-630.

Couth, R and Trois, C. 2010. *Carbon Emissions Reduction Strategies in Africa from Improved Waste Management*: A Review. University of KwaZulu Natal, Durban: Republic of South Africa.

Creswell, J.W. 2009. *Research design: Qualitative, quantitative and mixed methods approaches*. 3rd ed. New York: Sage Publications.

Creswell J.W. 2013. *Qualitative inquiry and research design – choosing among five approaches.* Thousand Oaks, California: Sage Publications.

Dao, V,., Langella, I., and Carbo, J. 2011. From Green to Sustainability: Information and a Intergrated Sustainability Framework. *Journal of Strategic Information Systems20(1)63-79.*

Data Monitor. 2009. Global Recession Drives Green IT Financing Trends. MarketWatch: Technology. Retrieved on 23 May 2015, from www.datamonitor.com october 2009.

Denscombe, M. 2003. *The good research guide for small-scale social research projects.* 2nd edition. Buckingham: Open University Press.

Devarajan, S, G, D.S., Robinson, S., and Thierfelder, K. 2009. Tax Policy to Reduce Carbon Emissions in South Africa. Report prepared for the World Bank program for Africa region climate change strategy.

Dittke, M. 2009. *A Review of South African Environmental and General Legislation governing e-waste*. Electronic Waste Association of South Africa, Cape Town: South Africa.

Drew, C.J., Hardman, M.J. & Hart, W. 1996. *Designing and conducting research: Inquiring in education and social sciences.* 2nd ed. Boston: Allyn & Bacon.

Doey, L., and Kurta, J. 2011. Correspondence Analysis applied to psychological research. *Tutorials in Quantitative Methods for Psychology, 7(1), 5-14.*

Du Plooy, G.D. 2001. *Communication research:Techniques, methods and publications*. Lansdowne, South Africa: Juta.

Du Preez, R., and Botha, R.A. 2010. A model for Green IT strategy: A Content Analysis Approach. (Unpublished MBA Dissertation), Johannesburg: Nelson Mandela Metropolitan University.

Easterbrook, S. 2010. Climate Change: A Grand Software Challenge. Paper presented at the *Proceedings of the FSE/SDP Workshop on Future of Software Engineering Research, 99-104.*

Easterby-Smith, M., Thorpe, R., and Lowe, A. 2002. *Management Research: An Introduction*, 2nd Edition, Sage Publications, London.

Eaton, D. 2013. Technology and Innovation for a Green Economy. *Review of European Community and International Environmental Law, 22(1): 62-67.*

Elliot, S. 2013. A Transdisciplinary Exploratory Model of Corporate Responses to the Challenges of Environmental Sustainability. *Business Strategy and the Environment, 22: 269-282.c;*

EPA Report. 2009. Hazardous Waste Report Istruction and Form. Office of Resource Conservation and Recovery. New York: United States Environmental Protection Agency.

Erek, K., Loeser, F., Schmidt, N., Zarnekow, R., and Kolbe, L.M. 2011. Green IT Strategies: A Case Study-Based Framework for Aligning Green IT with Competitive Environmental Strategies. Paper presented at the 15th Pacific Asia Conference on Information Systems (PACIS), Brisbane, Australia, 1-15.

Evans, D. 2017. Empirical evidence that humans are causing global warming. Skeptical Science. Retrieved from 24 May 2015, from https://www.skepticalscience.com/empirical-evidence-for-global-warming.htm

Fairweather, N.B. 2011. Even Greener IT: Bringing Green Theory and Green IT together or why concern about Greenhouse Gases is only a Starting Point. *Journal of Information, Communication and Ethics in Society, 9(2): 68-82.*

Fellenberg, K., Hauser, B., Brors, A., Neutzer, A., Hoheisel, J.D., and Vingron, M. 2001. Correspondence analysis applied to microarray dat. Proc Natl Acad Sci USA: 10786 [PMC free article] [PubMed].

Ferguson, C., Green, P., Vaswani, R., and Wu, G. 2013. Determinants of Effective Information Technology Governance. *International Journal of Auditing, 17: 75-99.*

Fink, A. 1995. *How to sample in Surveys*. London: Sage.

Fouche, C.B, and Delport, C.S.L. 2002. Introduction to the Research Process, in De Vos, A.S (Ed). *Research at Grass Roots*. Pretoria: Van Schaik Publishers.

Fox, W. and Bayat, M.S. 2011. *A Guide to Managing Research*. Cape Town: Juta.

Fuchs, C. 2008. The implications of new information and communication technologies for sustainability. *Environmental Development Sustainability, 10, 291-309.*

Gabriel, C. 2008. Why it's not naïve to be green. *Business Information Review, 25(4): 230-237.*

Gaidajis, G., Angelakoglou, K., and Aktsoglou, D. 2010. E-waste: Environmental Problems and Current Management. *Journal of Engineering Science and Technology Review, 3(1), 193-199.*

Gartner. 2008. The CIO's Role in Enterprise wide Environmental Sustainability. *International Journal of Computer Science Issues, 8(4), 424-427.*

Gavrilovska, D., Zdraveski, V., and Trajanov, D. ND. Implementation of Green IT concepts in R. Macedonia. *21st Telecommunications forum TELFOR. 21-24.* University Ss. Cyril and Methodius, Skopje: Macedonia.

Glaser, B., and Strauss, A. 1967. *The Discovery of Grounded Theory: Strategies for Qualitative Research*. New York: Aldine Pub.Co.

Green, D. L., and McCann, J. 2011. Benchmarking a leadership model for Green Economy. *Benchmarking: An International Journal, 18(3), 445-465*.

Greenacre, M. 2009. Power transformation in correspondence analysis. *Computational Statistics and Data Analysis*, 53, 3107-3116.

Gupta, V., Abidi, N., Bansal, T., and Jain, R. K. 2013. *Green Supply Chain Management Initiatives by IT Companies in India*. Jaypee Business School. India

Hamdouch, A., and Depret, M. 2010. Policy intergration strategy and the development of the green economy foundations and implementation patterns. *Journal of Environmental Planning and Management, 53(4), 473-490.*

Hanne, F. Z. 2011. Green IT: Why developing Countries Should Care?. *International Journal of Computer Science, 8(1), 424-427*.

Harmon, R. R., and Auseklis, N. 2009. *Sustainable IT Services: Assessing the Impact of Green Computing Practices*. Picmet Proceedings, Portland: USA.

Hasbrouck, J., and Woodruff, A. 2008. Green homeowners as Lead Adopters: Sustainable Living and Green Computing. *Intel Technology Journal, 12(1): 39-48.*

Hedman, J., and Henningsson, S. 2011. Three Strategies for Green IT. *IT Professional Magazine, 13(1), 54-57.*

Henderson, H. 2007. Growing the green economy – globally. *International Journal Green Economics, 1(4), 276-298.*

Herat, S. 2007. Sustainable Management of Electronic Waste. *Clean-Journal, 35(4), 305-310.*

Healy, M., and Perry, C. 2000. Comprehensive criteria to judge validity and reliability of qualitative research within the realism paradigm. *Qualitative Market Research, 3*(3): 118-126.

Hilty, L. M., Kohler, A., Von Scheele, F., Zah, R., and Ruddy, T. 2006. Rebound effects of progress in information technology. *Poiesis Prax, 4(1), 19-38.*

Hilty, L. M., and Lohmann, W. 2011. The Five Most Neglected Issues in Green IT. *CEPSIS UPGRADE, 12 (4), 12-15.*

Hodges, R. 2004. Go Green in ICT. Green Tech News, e- Newsletter.

Hodges, R., and White, W. ND. Go Green in ICT. Green Tech News. 1-2.

Hogan, R. 2011. How to Modify Technology and Business Practices within the Mid-Sized Service Organisation as a Way to Mitigate the Carbon Footprint. University of Oregon. Eugene.

Holmner, M.A., and Marais, L. 2013. Electronic Waste: The Leading Information Ethical Concern of the Information Age. University of Pretoria, Pretoria: South Africa.

Hollway,W., and Jefferson, T. 2000. *Doing qualitative research differently*: *Free association, narrative and the interview method.* London: Sage Publications.

Holloway, I., and Wheeler, S. 1996. *Qualitative Research for Nurses*. Oxford: Blackwell Science.

Hox, J.J., and Boeije, H.R. 2005. Data collection, Primary vs. Secondary. Encyclopaedia of Social Measurement, 1, 593-599.

Huang, A.H. 2009. A Model for Environmentally Sustainable Information Systems Development. *Journal of Computer Information Systems, 49(4), 114-121.*

ISO, Environmental management systems – specification with guidance for use, ISO standard 14001-1996,Geneva.

Jenkin, T.A., Webster, J., and McShane, L. 2011. An agenda for Green Information Technology and Systems Research. *Information and Organisations, 21(1),* 17-40.

Jorgensen, M.S., and Jorgensen, U. 2009. Green technology foresight of high technology: A social shaping of technology approach to the analysis of hopes and hypes. *Technology Analysis and Strategic Management, 21(3), 363-379.*

Jugovic, Z., Pecarski, D., Peulic, A., Jordovic, B., and Jevremovic, Z. 2013. Global Warming in the Era of Information and Technology. 17th International Research/Expert Conference: Trends in the Development of Machinery and Associated Technology. Istabul: Turkey.

Kahhat, R., and Williams, E. 2009. Product or Waste? Importation and End of Life Processing of Computers in Peru. *Environmental Science and Technology, 43(15), 6010-6016.*

Kavuri, S. 2013. Greenhouse Gas Emissions. Best Midwestern High School Writing 2013 Winners. Paper 2. Retrived on 22 May 2016, from
http://scholarworks.wmich.edu/hs_writing_2013/2

Khan, M.A., Khan, M.Z., Zaman, K., and Naz, L. 2014. Global Estimates of Energy Consumption and Greenhouse Gas Emissions. *Renewable and Sustainable Energy Reviews, 29: 336-344.*

Khor, M. 2012. Risks and Uses of Green Economy Concept in the Context of Sustainable Development, Poverty and Equity. Geneva: South Centre.

Khurrum, M., Bhutta, S., Omar, A., and Yang, X. 2011. Electronic Waste: A Growing Concern in Today's Environment. *Economics Research International, 1-8.*

Kiddee, P., Naidu, R., and Wong, M.H. 2013. Electronic Waste Management Approaches: An Overview. *Waste Management, 33: 1237-1250.*

King Committee on Governance. 2009. Draft Code of Governance Principles for South Africa – 2009 (King III). Institute of Directors in Southern Africa.

Klopper, R., and Lubbe, S. 2011. Using matrix analysis to achieve traction, coherence, progression and closure in problem-solution oriented research. *Alternation*, 18(2), 386-403.

Kothari, C. R. 2008. Research Methodology, Methods and Techniques (2nd Ed.) *Journal of Services Research, 7(2),109-110.*

Kohlbacher, F. 2005. The Use of Qualitative Content Analysis in Case Study Research. *Forum Qualitative Sozialforschung / Forum: Qualitative Social, 7 (1).*

Korte, M., Lee, K., and Fung, C. C. 2012. Evolving IT Management Frameworks Towards a Sustainable Future. In: 21st International Conference of Information Systems Development, Murdoch Unoiversity, Prato: Italy.

Krefting, L. 1991. Rigor in Qualitative Research: The Assessment of Trustworthiness. *American Journal of Occupational Therapy. 45, 214-222.*

Kreuger, L.W., and Neuman, W.L. 2006. *Social Work Research Methods with Research Navigato*r. Boston, MA: Pearson.

Kuo, B. N., and Dick, G.N. 2009. The Greening of Organisational IT: What Makes a Difference? *Australian Journal of Information System, 16(2), 81-92.*

Kurp, P. 2008. Green Computing. Are you Ready for a Personal Energy Meter? *Communications of the ACM, 51(10), 11-13.*

Kyoto Protocol. 1997. Kyoto protocol to the United Nations framework convention climate change.
Retrieved on 22 May 2016, from http://unfcc.int/resource/docs/convkp/kpeng.pdf.

Lake, R. 2014. What are the disadvantages of going green? Retrieved on 24 May 2016, from https://www.livestrong.com/article/137345-what-are-disadvantages-going-green/

Lakshmi, S.V.S.S., Sarwani, I.S.R., and Tuveera, M.N. 2012. A Study on Green Computing: The Future Computing and Eco-Friendly Technology. *International Journal of Engineering Research and Applications, 2(4):1282-1285.*

Lawhon, M. 2012. Contesting power, trust and legitimacy in the South African e-waste transition. *Policy Science, 45: 69-86.*

Lee, S. M., Park, S., and Trimi, S. 2013. Greening with IT: Practices of Leading Countries and Strategies of followers. *Management Decision, 51(3): 629-642.*

Leedy, P. D., and Ormrod, J. E. 2005. *Practical research planning and design*. 5th ed. New Jersey: Pearson Merrill Prentice Hall.

Leedy P.D., and Ormrod J.E. 2015. *Practical research – planning and design*. 10th ed. Boston: Pearson.

Leemans, R., and Solecki, W. 2013. Redefining Environmental Sustainability. *Curr Opin Environ Sustainability. 5(3-4), 272-277.*

Li, Y. 2017. Resource allocation in a Cloud partialy powered by renewable energy sources. Distributed, Parallel and Cluster Computing. Retrieved on 11 October 2017, from https://tel.archives-ouvertes.fr/tel-01595953/file/2017IMTA0019_LiYunbo.pdf.

Linnell, J. 2009. The e-waste patchwork. Waste Age,com. Retrieved on 15 April 2015, from http://www.waste360.com/ewaste/e-waste-patchwork

MacDonald, S., and Headlam, N. 2011. Research Methods Handbook. Introductory guide to research methods for social research. CLES. Retrieved on 15 April 2015, from http://www.cles.org.uk/wp-content/uploads/2011/01/Research-Methods-Handbook.pdf

Marshall, M.N. 1996. Sampling for quality research. *Family Practice, 13(6), 522-525.*

Mason, J. 1996. *Qualitative Researching.* London: Sage.

Mattern, F., Staake, T., and Weiss, M. 2010. ICT for Green – How Computers Can Help Us to Conserve Energy. Proceedings of e- Energy, Passau: Germany.

Mayers, K., France, C., Cleverly, A., Kabouris, E., and Planas, S. 2002. The use and disposal of IT products within commercial markerts. *Journal of Business and Inustrial Marketing, 17 (5), 357-378.*

McDaniel, C.F., and Gates, R. 2001. *Marketing Research Essentials*. 3rd edition. United States: Thompson Learning.

McFadzean, E. 2007. Quantitative versus Qualitative Research. Retrieved on 08 August 2016, from

http://distinctivemanagement.biz/Assets/courses/mbaKnowledgeBytes/Quantitative%20versus%20Qualitative%20Research_IC02.pdf

McNabb, D. (2nd Ed.) 2010. Research Methods for Political Science: Quantitative and Qualitative Approaches. M.E. Sharpe: New York.

Mingay, S. 2007. Green IT: The New Industry Shock Wave. Gartner RAS Core Research.

Mingay, S. 2010. E-waste and IT Asset Recycling. Allied Computer Broker. Converge. Intechra Group, Redemtech

Moisander, J. 2007. Motivational Complexity of Green Consumerism. *International Journal of Consumer Studies, 31: 404-409.*

Mojsilovic, A., Ray, B., Lawrence., and Takriti, S. 2007. Alogistic regression framework for Information Technology outsourcing lifecycle management. *Computers and Operations Research, 34, 3609 – 3627.*

Molla, A. 2009. Organisational Motivations for Green IT: Exploring Green IT Matrix and Motivation Models. Pacific Asia Conference on Information Systems (PACIS). School of Business Information Technology, RMIT University – Melbourne, Australia.

Molla, A., and Abareshi, A. 2012. Organisational Green Motivations for Information Technology : Emirical Study. *Journal of Computer Information Systems, 52(3),92-102.*

Molla, A., Cooper, V., Corbitt, B., Deng, H., Peszynski, K., Pittayachawan, S., and Teoh, S. 2008. E-readiness to G-readiness: Developing a Green Information Technology readiness framework. Paper presented at the *19th Australian Conference on Information Systems (ACIS),* Christchurch, New Zealand, 669-678.

Morelli, J. 2013. Environmental Sustainability: A Definition for Environmental Professionals. *Journal of Environmental Sustainability, 1(1):1-9.*

Morgan, D.L., and Krueger, R.A. 1998. *The Focus Group Kit*, Thousand Oaks, CA: Sage Publications.

Morgan, D. L. 1998. *The focus group guidebook.* Thousand Oaks, CA: Sage Publications.

Mouton, J. 1996. *Understanding social research*. Pretoria: Van Schaik Publishers.

Mouton, J., and Marais, H. 1990. *Basic concepts in the methodology of social research.* Pretoria: Human Research Council.

Murugesan, S. 2008. Harnessing Green IT: Principles and Practices. *IT Professional, 10(1), 24-33.*

Murugesan, S. 2010. Making IT Green. *IT Professional Magazine, 12(2), 4-5.*

Murugesan, S. 2013. How green is IT? Retrieved on 07 March 2018, from http://www.computer.org/portal/web/computingnow/achieve/april2013.

Murugesan, S., Gangadharan,G.R., Harmon, R.R., and Godbole, N. 2013. Fostering Green IT [Guest editors' introduction]. *IT Professional, 15(1), 16-18.*

Murugesan, S., and Molla, P. 2011. On Harnessing Green IT and Cloud Computing. *SETLabs Briefings, 9(1): 39-48.*

Muzenda, E. 2013. Recycling Situation in South Africa: A Discussion. *International Journal of Biological, Ecological and Environmental Sciences (IJBEES), 2(4), 79-82.*

Nayab, N. 2011. Concept of Green Technology: How it all began. Retrieved on the 04 April 2018, from https://www.brighthub.com/environment/green-computing/articles/71176.aspx

NASA Global Climate change Vital Signs of the planet. Scientific consensus: Earth's climate is warming. 2014. Retrieved on the 23 October 2014, from https://climate.nasa.gov/scientific-consensus/

Neuman, L.W. 1997. '*Social Research Methods: Qualitative and Quantitative Approaches'.* Needham Heights, MA: Allyn & Bacon

Neuman, W.L. 2006. *Social Research Methods: Qualitative and Quantitative Approaches*. Toronto: Pearson.

Newton, P., and Burgess, D. 2008. Exploring Types of Educational Action Research. Implication for Research Validity. *International Journal of Qualitative Method*, 2008. 18-30.

Ng, S.T., Chen, Y., and Wong, J.M.W. 2013. Variability of Building Environmental Assesment Tools on Evaluating Carbon Emissions. *Environmental Impact Assesment Review, 38:131-141*.

Ngoepe, M., and Ngulube, P. 2013. An exploration of the role of record management in corporate governance in South Africa, *South African Journal of Information Management, 15(2) 1-8.*

Nicholls, D. 2009. Qualitative research: Part Two Methodologies. *International Journal of Therapy and Rehabilitation, 16(11), 596-592.*

Nishant, R., Teo, T.S.H., and Goh, M. 2012. Understanding the Environmental Impact of Sustainable IT: An Emperical Examination. University of Singapore:Singaphore.

Nnorom, I.C., and Osibanjo, O. 2008. Overview of electronic waste (ewaste) management practices and legislations, and their poor applications in the developing countries. *Resources, Conservation and Recycling, 52, 843-858.*

O'Keefe, P., O'Brien, G., and Pearsall, N. 2010. The future of energy use. London: Earthscan.

Olson, E.G. 2008. Creating an Enterprise-level Green Strategy. *Journal of Business Strategy, 29 (2), 22-30.*

Onwughara, N.I., Nnorom, I.C., Kanno, O.C., and Chukwuma, R.C. 2010. Disposal Methods and Heavy Metals Released from Ceratin Electrical and Electronic Equipment Waste in Nigeria: Adoption of Environmental Sound Recycling System. *International Journal of Environmental Science and Development, 1(4), 290 – 297.*

Onwughara, I., Nkwachukwu, N, Innoccent, C., and Kanno, O.C. 2010. Issues of Roadside Disposal Habit of Muncipal Solid Waste, Environmental Impacts and Implementation of Sound Management Practices in Developing Country 'Nigeria". *International Journal of Environmental Science and Development,1(5), 409-418.*

Osibanjo, O., and Nnorom, I.C. 2007. The Challenge of electronic waste (e-waste) management in developing countries. *Waste Management and Research, 25, 489-501.*

Paletta, F.C., and Junior, N.D.V. 2013. ICT Lifecycle and its major Role in the Development of Strategic Intelligence. *Journal of Intelligence Studies in Business, 2:62-78.*

Packhard, K.O., and Reinhardt, F. L. 2007. What Every Executive Needs to Know About Global Warming. *Havard Business Review, 78 (4), 128-135.*

Parthasarathy, P., Bulbule, K.A., and Murthy, K.S. 2008. E-waste Recycling-Best Option for Resources Recovery and Sustainable Environment. *Research Journal of Chemistry and Environment, 12(1), 93- 98.*

Petzer, C., McGibbon, C., and Brown, I. 2011. Adoption of Green IS in South Africa: An exploratory study. Paper presented at the *South African Institute of Computer Scientists and Information Technologists (SAICSIT) Conference,* Cape Town, South Africa. 330-333.

Plambeck, E., and Wang, Q. 2009. Effects of E-waste Regulation on New Product Introduction. *Management Science, 55(3), 333 – 347.*

Pollard, C. 2013. The US Government's Evolving Role in IT Energy Management. *Journal of IT Management, 36-43.*

Pretorius, H., Leonard, A., and Strydom, I. 2013. Towards an Electronic Monitoring, Observation and Compliance Framework for Corporate Governance using Business Process Management Systems. *The African Journal of Information and Communication, 62-75.*

Principe, D. 2014. Understanding Pollution: The Truth about Air we breathe. Retrieved on 14 May 2015, from
https://understandingpollution.com/page/5/

Proceedings of the 23rd British HCI Group Annual Conference on People and Computers: Celebrating People and Technology. Cambridge, United Kingdom — September 01 - 05, 2009.

Rahim, R.E.A., and Rahman, A.A. 2013. Green IT Capability and Sustainable Development. University of Teknologi: Malaysia.

Ramayah, T., Siew, K.K., Ahmad, N.H., Halim, H.A., and Lo, M. 2013. An Exploratory Study of Green IT Adoption Issues among SMEs. *Life Science Journal, 10(12): 246-255.*

Remenyi, D. 1996. *So you want to be an academic researcher in business and management studies! Where do you start and what are the key philosophical issues to think about?* Johannesburg: University of the Witwatersrand.

Republic of South Africa. 1996. *The Constitution of the Republic of South Africa Act, 1996 (Act 106 of* 1996). Pretoria: Government Printer.

Republic of South Africa. 1977. *Health Act of the Republic of South Africa Act, 1997 (Act 63 of* 1977). Pretoria: Government Printer.

Republic of South Africa. 1998. *National Environmental* Act *of the Republic of South Africa Act, 1987 (Act 107 of* 1978). Pretoria: Government Printer.

Republic of South Africa. 1998. *National Water Act of the Republic of South Africa Act, 1998 (Act 36 of* 1988). Pretoria: Government Printer.

Republic of South Africa. 1993. *Occupational Health and Safety Act of the Republic of South Africa Act, 1993 (Act 85 of* 1993). Pretoria: Government Printer.

Riaz, M.T., Gutierrez, J.M., and Pedersen, J.M. 2009. Strategies for the next generation Green ICT Infrastructure. Aalborg University: Denmark.

Riessman, C.K. 2003. "Performing identities in illness narrative: Masculinity and multiple sclerosis", *Qualitative Research*, 3(1).

Robinson, B.H. 2009. E-waste: An assessment of global production and environmental impacts. *Science of the Total Environment, 408: 183 – 191.*

Robinson, T. 2010. Go Green or Go Home. Blackenterprise. Retrieved on 22May 2015, from http://www.blackenterprise.com/mag/go-green-or-go-home/

Roe, B.R., and Just, D.R. 2009. Internal and External Validity in Economics Research: Trade-off between Experiments, Field Experiments, Natural Experiments and Field Data. *American Journal of Agricultural Economics, 9(5), 1266-1271.*

Rogers, K., Jenkin, T.A., Corbett, J., and Webster, J. 2013. The Effects of Green IT/S Projects: Recycling the Garbage Can Model. *Hawaii International Conference on System Sciences, 46, 974-983.*

Roosa, S.A., and Jhaveri, A.G. 2009. *Carbon Reduction: Policies, strategies and technologies.* Lilburn, GA: The Fairmont Press.

Roztocki, N., and Weistroffer, H.R. 2011. InformationTechnology Success Factors and Models in Developing and Emerging Economies. *Information Technology for Development, 17(3): 163-167.*

Ruth, S. 2009. Green IT – More than a Three Percent Solution. *IEEE Internet Computing, 13(4), 74-78.*

Saha, B. 2014. Green Computing. *International Journal of Computer Trends and Technology (IJCTT), 14(2), 46-50.*

Saldana, J. 2013. *The coding manual for qualitative researchers*, 2nd Ed., Sage, London.

Salmani, B., and Sharifian, M. B. ND. Green Mobile Technology: Priciples and Practices. *International Journal of Technology in Computer Science and Engineering, 1(1):1-8.*

Saphores, J.M., Nixon, H., Ogunseitan, O.A., and Shapiro, A.A. 2009. How much e-waste is there in US basements and attics? Results from a national survey. *Journal of Environmental Management, 90(11), 3322-3331.*

Sarkar, P.K., and Young, L.W. 2009. Managerial Attitudes towards Green IT: An Explorative Study of Policy Drivers. *Pacific Asia Conference on Information Systems. Association of Information Systems.* Australia: Melbourne.

Saunders, M., Lewis, P., and Thornhill, A. 2003. *Research method for business students, 3rd edition.* New York: Prentice Hall.

Saunders, M., Lewis, P. and Thornhill, A. 2007. *Research Methods for Business Students*. 4th Edition . Harlow. Prentice Hall Financial Times.

Schiffman, S. 2015. The impact of green management and technology in electrical and electronics. Retrieved on 22 May 2016, from https://www.researchgate.net/publication/283799597_The_impact_of_green_management_and_technology_in_electrical_and_electronics_manufacturing_in_business_sustainability_in_Malaysia

Schurink, W.J. 2003. Qualitative research in management and organizational studies with reference to recent South African research. *South African Journal of Human Resource Management, **1**(3), 2-14.*

Seidel, S., and Recker, J. 2011. Green Business Process Management and a Call for Action. Queensland University of Technology. Brisbane: Australia.

Sekaran, U. 2003. *Research methods for business: A skill building approach*, 4th edition, John Wiley & Sons.

Semine, N. 2009. Green Technologies: Opportunities for South – South Trade. *International Trade Forum, 34-35.*

Shah, R. 2012. Eco-Friendly IT: Greener Approach of IT. *Journal of Management and Business Research, 2(2), 4-24.*

Shagun., Kush, A., and Arora, A. 2013. Proposed Solution of e-Waste Management. *International Journal of Future Computer and Communication, 2(5): 490-493.*

Shawkat, E.E. 2016. Green Business: The Light of New possibilities. Retrieved on 17 September 2017, from https://www.linkedin.com/pulse/green-business-light-new-possibilities-shawkat-emran-emon

Shuanggui, Y., Jing, Y., and Shiyuan, D. 2011. The Research on the City Life of Green Information. *Procedia Engineering, 21: 252-257.*

Siddiqui, J. 2013. Green Computing: Protect Our Environment from Computer and its Devices. *An International Journal of Advanced Computer Technology, 2(12): 410-414.*

Silvis, J. 2015. The Cost of Going (or not Going) Green. Retrieved on 22 May 2015, from https://www.healthcaredesignmagazine.com/architecture/cost-going-or-not-going-green/

Sinha, M. 2011. Green Information Technology: A Strategy to become Socially Responsible Software Organization. *International Journal of Enterprise Computing and Business System, 1 (2), 2011.*

Sinkovics, R.R., and Alfodi, E.A. 2012. Progressive Focusing and Trustworthiness in Qualitative Research. *Management Int Rev. 52, 817-845.*

Smith, E.E., and Perks, S. 2010. A Perceptual Study of the Impact of Green Practice Implementation on the Business Functions. *South African Business Review, 14(3): 1-29.*

Smith, G.R. 2004. How green is technology? The paradox of online sustainable education. *International Journal of Sustainable Development and World Ecology*, *11(1), 262-270.*

Stansberry, M. 2013. The Future of Green IT: Solving the AccountabilityIssue. *IEEE Computer Society*, *91-93.*

Stake, R. 1995. *The art of case study research* (pp. 49-68). Thousand Oaks, CA: Sage.

Starkey, R., and Anderson, K. 2005. Domestic Quotas: A Policy Instrument for Reducing Greenhouse Gas Emissions from Energy Use. Technical Report 39. Tyndall Centre for Climate Change Research. Retrieved on 23 May 2015, from http://www.tyndall.ac.uk/research/theme2/final_reports/t3_22.pdf

Stanisz, A. 2007. Przystepny kurs statystyki z zastosowaniem pakietu STATISTICA PL na prykladach z medycyny, Tom 3, Analizy wielowymiarowe, Statsoft, Krakow 2007, str. 307-353.

Stemler, S. 2001. An Overview of Content Analysis. *Practical Assessment, Research & Evaluation*, *7 (17),* 137-146.

Steenkamp, G. 2011. The applicability of using COBIT as a framework to achieve compliance with King III Report's requirements for good IT governance. *South African Journal of Accountability and Auditing Research, 11(1), 1-8.*

Steward, R.A. ND. A Framework for the Life Cycle Management of Information Technology Projects: Project IT. School of Engineering. Griffith University Gold Coast Campus, Queesland: Australia.

Sthiannopkao, S., and Wong, M.H. 2013. Handling e-waste in developed and developing countries: Initiaves, practices, and consequences. *Science of the Total Environment, 1147-1153.*

Struwig, F.W., and Stead, G.B. 2010. *Planning, designing and reporting research*. Cape Town: Maskew Miller Longman (Pty) Ltd.

Talebi, M., and Way, T. 2009. Methods, Metrics and Motivation for a Green Computer Science Program. Department of Computing Sciences, Villanova University: USA.

Tallon, P., and Scannell, R. 2007. Information Life Cycle Management. *Communication of the ACM, 50(11), 65-69.*

Tanskanen, P. 2013. Management and Recycling of Electronic Waste. *SciVerse ScienceDirect, 61:1001-1011*.

Terazono, A., Murakami, S.A.N., Inanc, B., and Moriguchi, Y. 2006. *Journal Material of Waste Management, 8, 1-12.*

The Editors. 2009. Towards Green ICT Strategies. Communication and Strategies, no. 76, 4th quarter 2009.

The Zacharias Group. ND. Qualitatitive Research Process. Retrieved on 22 June 2018, from http://www.zachariasgroup.com/services/qualitative-research

Thibodeau, P. 2008. Environmental impact: IT Sees the Light on Green Computing. *Computer world. (June 30/July 7, 2008), 10-11*.

Tocho, J. A., and Waema, T. M. 2013. Towards an e-Waste Management Framework in Kenya. University of Nairobi: Kenya. *15(5):99-113.*

Tomlinson, B. 2010. *Greening through IT: Information Technology for Environmental Sustainability*. The MIT Press. London: England.

Trimi, S., and Park, S. 2013. Green IT: Practices of leading firms and NGOs. *Service Business, 7:363-379.*

Trochim, W.M.K. 2006. *Ethics in research*. [Online]. Available at http://www.socialresearchmethods.net/kb/ethicsphp. Accessed on 2013-03-10.

Uddin, M., and Rahman, A.A. 2012. Energy Effeciency and Low Carbon Enabler Green IT Framework For Data Centres Considering Green Metrics. *Renewable and Sustainable Energy Reviews 16 :4078-4094.*

UNEP. 201l. *Year book 2011: Emerging issues in our global environment.* Nairobi, Kenya: United Nations Environment Programme. ISBN: 978-92-807-3101-9. Retrieved 12 October 2011, from http://www.unep.org/yearbook/2011/pdfs!UNEP YEARBOOK_Fullreport.pdf.

UNEP. 201l. *Year book 2011: Emerging issues in our global environment.* Nairobi, Kenya: United Nations Environment Programme. ISBN: 978-92-807-3101-9. Retrieved 21 October 2014, from http://www.unep.org/yearbook/2011/pdfs!UNEP YEARBOOK_Fullreport.pdf.

UNFCCC. 2009. Framework Convention on Climate. Report of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol on its fifth session, held in Copenhagen from 7 to 19 December 2009
https://unfccc.int/sites/default/files/resource/docs/2009/cmp5/eng/21a01.pdf

Unhelkar, B. 2011. Green IT: The Next Five Years. *IEEE Computer Society, 56-59.*

United Nations Framework Convention on Climate Change (UNFCCC). 2009. Report of the Conference of Parties on its fifteenth session, held in Copenhagen from 7 to 19 December 2009. University of Queensland: Asia –Pacific Model United Nations Conference (AMUNC). Retrieved on the 06 February 2015, from
http://uq.edu.au/youngscholars/docs/2009/UNFCC_COP_15_Topic_A.pdf.

Ursery, S. 2010. E-waste Decline ? Tipoff. Retrieved on 18 February 2017, from
http://ohiocitizen.org/wp-content/uploads/2010/10/Oct-2010.pdf

Valanju, S.S. 2008. Green Computing is the Utmost Requirement.Silicondia, 11(9), 26-27.

Venkatesh, V., Brown, S., and Bala, H. 2013. Bridging the Qualitative-Quantitative Divide: Guidelines for Conducting Mixed Methods Research in Information Systems. *MIS Quarterly, 37(1), 21-54.*

Vereecken, W., Van Heddeghem, W., Colle, D., Pickavet, M., and Demeester, P. 2010. Overall ICT Footprint and Green Communication Technologies. Ghent University: Belgium.

Vesilind, P.A., Heine, L., and Hendry, J. 2006. The Moral Challenge of Green Technology. *Trames: A Journal of the Humanities and Social Sciences, 10(1), 22-31.*

Viaro, T.A., and Vaccaro, G.L.R. 2010. A Conceptual Framework to Develop Green IT: Going Beyond the idea of Environmental Sustainability. XVI International Conference on Industrial Engineering and Operations Management. Sao Carlos: Brazil.

Victor, E.I. 2017. Journal Paper on Curbing Climate Change in Nigeria by Adoption of Green Computing. Retrieved on 22 March 2017, from http://www.publiseer.com/2017/10/journal-paper-on-curbing-climate-change.html

Vine, E., and Hamrin, J. 2008. Energy Saving Certificates: A Market-Based Tool for Reducing Green House Gas Emissions. *Energy Policy, 36(1), 467-476.*

Vykoukal, J., Wolf, M., and Beck, R. 2009. Does Green IT Matter? Analysis of the Relationship between Green IT and Grid Technology from a Resource-Based View Perspective. *Pacific Asia Conference on Information Systems (PACIS) Proceeding Paper 51*. Retrieved on 23 May 2015, from http://aisel.aisnet.org/pacis2009/51

Waiti, Y., and Koo, C. ND. Assessing Factors Affecting Electronics Companies to Execute Green IT Practices: Content Analysis Approach. College of Business, Chosun University.

Walker, G., and Cass, N. 2007. Carbon reduction, the public and renewable energy: engaging with socio-technical configuration. *Journal compilation, 39(4), 458-469.*

Walker, M. 2017. The real problem with Green IT and how to solve it. Retrieved on 20 March 2018, from https://www.greenbiz.com/article/real-problem-green-it-and-how-solve-it

Wath, S.B., Dutt, P.S., and Chakrabarti. 2011. E-waste scenario in India, its management and implications. *Environmental Monitoring Assesment, 172, 249-262.*

Watson, M. 2009. Security and disposal. The British Computer Society. Oxford University: United Kingdom.

Webster, J., and Watson, R.T. 2002. Analyzing the past to prepare for the future: Writing a literature review. *MIS Quartely, 26 (2), xiii-xxiii.*

Welfens, P.J.J., and Lutz, C. 2012. Green ICT dynamics: Key issues and findings for Germany. *Miner Economics, 24, 155-163.*

Welman, J.C., and Kruger, S.J. (2nd Ed) 2003. *Research Methodology*. Cape Town: Oxford University Press.

Westmarland, Louise. 2011. *Researching crime and justice: tales from the field*. New York: Routledge.

Whitley, J.A. 2001. A study of Computer Obsolescene and its impact. MSc Thesis, Towson University: Maryland, USA, 2001.

Whitmarsh, L. 2009. What is a name? Commonalities and differences in Public understanding of Climate Change and Global Warming. *Public Understanding of Science, 18(4), 401-420.*

Widjaja, N.D., Mariani, M., and Imam, K. 2011. IT Professional Awareness: Green IT International Comparison Study. Communication of the IBIMA,Binus International University, Jakarta: Indonesia.

Widmer, R., Krapf, H., Sinha-Khetriwal, S., Schnellmann, M., Heinz, B. 2005. Global perspective on e-waste. *Environmental Impact Assesment Review, 25, 436-458.*

Williams, E., Kahhat, R., Allenby, B., Kavazanjian, E., Xu, M., and Kim, J. 2008. Sustainability Review of the International Reverse Chain for Reuse and Recycling of Computers. *Environmental Science Technology. 42(17), 6446-54.*

Wunsch, C., Schmitt, R.W., and Baker, D.J. 2013. Climate Change as an intergenerational problem. Harvard University, Washington DC: United States of America.

Yi, L., and Thomas, H.R. 2007. A review of research on the environmental impact of e-business and ICT. Cardiff University: London: United Kingdom.

Yin, R.K. 2003. Applications of a Case Study Research (2nd Ed.). Thousand Oaks, CA: Sage.

Young, W., and Middlemiss, L. 2012. A rethink of how policy and social science approach changing individuals' actions on greenhouse gas emissions. *Energy Policy, 41(1), 742-747.*

Yunus, S., Jailani, S.F.A.K., Hairuddin, H., and Kassim, E.S. 2013. Green IT Adoption towards Environmental Sustainability: The Moderating Role of Top Management Enforcement. *3rd International Conference on Research and Innovation in Information Systems, 241-244.*

Zhang, J., and Liang, X. 2012. Promoting Green ICT in China: A Framework based on innovation system approaches. *Telecommunications Policy, 36, 997-1013.*

APPENDICES

APPENDIX 1: LITERATURE MATRIX

	Author	Greenhouse gas emission	Carbon footprint	Carbon reduction	ENVIRONMENTAL IMPACT	Ecological issues	Climate change	E-WASTE	Hazardous raw material	IT waste disposal	ENERGY CONSUMPTION	Data center	Data power energy	Energy cost	Energy saving	Energy efficiency & Renewal energy	CORPORATE GOVERNANCE	Regulations driving Green IT	Environmental sustainability	GREEN IT STRATEGIES	Green economy	Green design	IT life cycle management	IT best practices
1	14th Annual IEEE/ACM international symposium											1			1	1								
2	Adhikary, 2008					1													1			1		
3	Advanced Tropical Environment (ATE)							1	1	1														
4	Albertson, S.E.2008	1						1					1		1	1							1	
5	Andreopolou, Z.S. 2012	1	1	1		1					1				1				1					
6	An Enterprise Management Associates (EMA), 2008			1			1				1	1		1		1			1	1				
7	Atkinson et al, 2010	1		1			1																	
8	Avvannavar, S.M and Shrihari, S. 2007							1										1						
9	Bandyopadhyay, 2008							1	1	1														
10	Basel Convention, 1989							1	1	1														
11	Bate, R. 2005	1			1	1	1																	

12	Bates, M., Pillips, P., and Mbeng, L, 2008							1	1	1														
13	Begum, K.J.A. 2013							1	1	1								1						
14	Beluz, J., Plumer, B., and Resnick, B. 2016.				1		1																	
15	Berghout, E., Nijlan., M and Powell, P. 2011																						1	
16	Berthon et al, 2010	1				1	1	1	1	1				1					1					
17	Billinghurst, B.M. 2005.	1			1	1	1		1															
18	Binns et al.,2006	1			1	1		1																1
19	Boccaletti, G., Loffler, M., and Oppenheim, J.M. 2008	1	1									1	1		1	1								
20	Boiral, O. 2006.				1		1																	
21	Borggren et al, 2013			1		1	1																	
22	Bose, R. and Luo, X. 2011	1				1				1	1		1		1	1			1	1				
23	Botes, A. 2012. SA’s Total Carbon Emissions	1			1			1	1			1			1	1		1					1	
24	British Computer Society, 2009																							
25	Brooks, S., Wang, X., and Sarker, S. 2012				1	1	1	1			1	1							1					1
26	Buckby, S. 2008													1	1	1								
27	Butler, T. 2010.	1			1		1		1	1	1				1	1		1	1	1				
28	Cai, S., Chen, X., and Bose I. 2013				1					1		1												
29	Cairns, C.N. 2005.				1			1	1															
30	Cameron, K.W. 2009		1								1													
31	Campbell,W.M., Ratcliffe, M., and Moore, P. 2013	1	1		1	1		1			1	1					1							
32	Canadian International Development Agency. Report, 2015																							1
33	Carter, P. 2009				1			1			1			1										
34	Cater-Steel, A, and Tan, W. 2010	1		1			1	1			1					1								

35	Chai, S., Chen, X., and Bose, I. 2013										1			1		1								
36	Chakravarthy, V.J., Kumar, P. H., and Ragav, R. 2013	1			1			1			1	1			1									
37	Charnovitz, S. 2012				1													1						
38	Chaudhuri et al., 2008				1																			
39	Chawla, N. 2013		1								1	1				1			1					
40	Chen, J.W, Boudreau, M, Watson, R.2008	1			1	1											1							
41	Chibunna et al,2009		1					1											1					
42	Childs, S. 2008				1		1																	1
43	Chong et al. 2010																							
44	Chou, D. C. 2013.	1			1	1	1	1			1				1		1		1	1				
45	Chou, D.C, and Chou, A. Y. 2012				1		1	1	1		1					1			1			1		
46	Chow, W.S., and Chen, Y., 2009	1						1	1	1						1			1					
47	Chowdhury, G. 2012.	1	1		1	1	1								1				1					
48	Christy, J.R., Norris, W.B, and McNider, R.T. 2009					1	1																	
49	Chuang, S., and Huang, S. 2015			1	1														1					
50	Chung, C, and Wee, H. 2010					1				1								1						
51	Clarke, K. 2009.				1			1						1										
52	Couth, R and Trois , C. 2010	1	1			1	1	1																
53	Dao, V,., Langella, I., and Carbo, J. 2011																1		1					
54	Data Monitor, 2009	1									1	1		1		1				1				
55	Devarajan et al.,2009	1		1			1				1								1					
56	Dittke, M. 2009	1			1			1	1															
57	Du Preez, R. and Botha, R.A. 2010	1			1	1	1	1	1		1	1		1	1	1	1	1	1		1			1
58	Easterbrook, S. 2010	1					1				1								1					
59	Eaton, D. 2013	1			1		1														1			

60	Elliot, S. 2013.										1								1					
61	EPA Report. 2009.				1	1		1	1															
62	Erek, K et al., 2011	1	1	1	1												1			1				
63	Evans, D. 2017.	1	1		1	1	1																	
64	Fairweather, 2011				1		1	1																
65	Ferguson et al., 2013																1							
66	Fuchs, C. 2008	1			1	1		1	1	1					1				1					
67	Gabriel, C. 2008	1	1	1	1	1	1																	
68	Gaidajis, G., Angelakoglou, K., and Aktsoglou, D. 2010				1			1				1			1									
69	Gartner. 2008	1	1	1	1	1					1								1					
70	Gavrilovska, D., Zdraveski, V., and Trajanov, D. ND	1					1	1	1			1				1			1					
71	Green, D.L, and McCann, J. 2011.																			1	1			
72	Gupta et al., 2013				1			1	1					1		1								
73	Hamdouch, A, and Depret, M. 2010																							
74	Hanne, F.Z. 2011.				1	1		1	1		1	1			1			1						
75	Harmon, R.R and Auseklis, N. 2009	1	1		1	1	1	1	1		1	1		1		1	1		1	1		1		
76	Hasbrouck, J., and Woodruff, A. 2008	1		1			1													1				
77	Health Act of South Africa (Act 63 of 1977)	1			1			1	1															
78	Hedman, J and Henningsson, S. 2011											1				1					1	1		
79	Henderson, H. 2007.						1														1			
80	Herat, S. 2007.							1	1	1												1		
81	Hilty and Lohmann, 2011	1	1																					
82	Hilty et al., 2006										1													
83	Hodges and White (ND)	1	1			1								1						1				
84	Hodges, R. 2004							1						1						1				

85	Hogan, R. 2011.			1				1			1	1							1					
86	Holmner,M.A., and Marais, L. 2013				1	1		1	1	1														
87	Huang, A. H. 2009.	1	1			1	1	1			1					1			1					
88	ISO, Environmental management systems, 1996		1		1			1										1						
89	Jenkin, T.A., Webster, J, and McShane, L. 2011	1	1		1	1		1			1			1		1			1	1				
90	Jorgensen, M.S, and Jorgensen, U. 2009	1		1	1		1				1								1					
91	Jugovic et al, 2013						1																	
92	Kahhat, R, and Williams, E. 2009							1	1															
93	Kavuri, S. 2013	1	1		1	1	1																	
94	Khan et al., 2014	1			1	1	1				1					1								
95	Khurrum et al., 2011				1			1	1									1						
96	Khor, M. 2012.	1			1	1															1			
97	Kiddee, P., Naidu, R., and Wong, M.H. 2013				1			1	1	1														
98	King Committee on Governance. 2009																1							
99	Korte, M., Lee, K., and Fung, C. C. 2012				1	1													1				1	
100	Kuo, B. N, and Dick, G.N. 2009.																							
101	Kurp, P. 2008		1		1							1			1				1					
102	Kyoto Protocol. 1997	1	1	1	1	1	1																	
103	Kyoto Protocol and Copenhagen Regional Report. 2009	1	1	1	1	1	1	1	1	1														
104	Lake, R. 2017				1									1		1								
105	Lakshmi,S.V.S.S., Sarwani, I.S.R., and Tuveera,M.N. 2012	1	1	1	1	1	1																	
106	Lawhon, M. 2012						1	1									1	1						
107	Lee, S. M., Park, S., and Trimi, S. 2013	1	1	1	1		1				1					1			1					

108	Leemans, R., and Solecki, W. 2013	1	1		1	1													1					
109	Li, Y.2017.											1		1	1									
110	Linnell, J. 2009.							1										1						
111	Mattern, F., Staake, T., and Weiss, M. 2010						1							1	1	1			1					
112	Mayers et al., 2002							1																
113	Mingay, S. 2007				1		1	1			1	1	1	1	1	1			1	1				1
114	Moisander, J. 2007				1	1	1																	
115	Mojsilovic et al., 2007																			1				
116	Molla and Abareshi, 2012	1	1	1	1			1		1	1	1		1		1			1	1				
117	Molla et al., 2008	1	1	1	1	1	1	1									1							
118	Molla, A., 2009	1					1	1		1								1	1					
119	Molla, A. and Abareshi, A. 2012	1		1	1	1	1	1						1			1		1	1				
120	Morelli, J. 2013.	1	1	1	1	1	1																	
121	Murugesan et al., 2013	1		1	1		1					1				1			1					
122	Murugesan, 2008	1	1	1	1	1	1	1	1	1	1	1			1	1			1			1	1	
123	Murugesan, S. 2010		1				1	1			1	1							1			1		
124	Murugesan, S. 2008.	1		1	1	1		1	1		1	1	1	1	1	1			1					
125	Murugesan, S., and Molla, P. 2011				1			1							1	1	1	1	1	1				
126	Muzenda, E. 2013							1	1															
127	NASA Global Climate Change.2014	1	1	1	1	1	1																	
128	National Environmental Act (Act 107 of 1978).				1	1																		
129	National Water Act (Act 36 of 1988).	1			1																			
130	Nayab, N. 2011	1	1	1	1	1						1			1									
131	Ng, S.T., Chen, Y., and Wong, J.M.W. 2013	1			1	1	1									1								
132	Ngoepe, M and Ngulube, P. 2013																1							

133	Nishant, R., Teo, T.S.H., and Goh, M. 2012	1	1	1	1		1	1			1	1							1					
134	Nnorom, I.C and Osibanjo, O. 2008				1			1	1									1	1					
135	O'Keefe, P., O'Brien, G., and Pearsall, N. 2010.				1						1													
136	Occupational Health and Safety Act (Act 85 of 1993)																	1						
137	Olson, E.G. 2008.	1	1		1	1	1												1	1				
138	Onwughara et al., 2010							1	1															
139	Onwughara et al., 2010 (b)	1			1	1		1	1									1	1					
140	Osibanjo, O and Nnorom, I.C. 2007	1			1	1		1	1									1	1					
141	Packhard, K.O. and Reinhardt, F. L. 2007	1				1	1											1	1					
142	Paletta, F.C., and Junior, N.D.V. 2013																					1	1	
143	Parthasarathy, P, Bulbule, K.A and Murthy, K.S. 2008							1																
144	Petzer, C., McGibbon, C., & Brown, I. 2011	1	1		1	1	1										1	1	1					
145	Plambeck, E., and Wang, Q. 2009							1	1									1						
146	Pollard, C. 2013.	1						1							1	1								
147	Pretorius ,H., Leonard, A., and Strydom, I. 2013				1													1	1					
148	Principe, D. 2014.	1	1		1	1	1																	
149	Proceedings of the 23rd British HCI Group Annual Conference, 2009	1	1	1	1		1																	
150	Rahim, R.E.A., and Rahman, A.A. 2013	1			1	1					1	1	1		1									
151	Ramayah et al., 2013	1		1	1	1	1	1	1		1					1								
152	Riaz, M.T., Gutierrez, J.M., and Pedersen, J.M. 2009	1	1	1	1							1	1	1										
153	Robinson, B.H. 2009	1			1	1		1																

154	Robinson, T. 2010		1		1										1									
155	Rogers et al, 2013				1														1	1				
156	Roosa and Jhaveri, 2009	1	1	1	1	1	1				1					1			1					
157	Roztocki, N., and Weistroffer, H.R. 2011				1														1					
158	Ruth, S., 2009.	1	1			1		1	1	1		1		1		1								
159	Saha, B. 2014				1														1					
160	Salmani, B., and Sharifian, M. B. ND.				1			1	1															
161	Saphores et al., 2009							1	1															
162	Sarkar, P.K., and Young, L.W. 2009																	1		1				
163	Schiffman, 2014							1	1									1						
164	Seidel, S and Recker, J. 2011	1			1							1				1			1			1		
165	Semine, 2009			1			1	1						1										
166	Senefelder, S. Wade, S. Wilson, and S. Cohen, 2006,							1	1															
167	Shagun., Kush, A., and Arora, A. 2013	1			1			1	1															
168	Shah, R. 2012	1				1					1					1		1	1					
169	Shawkat, EE	1				1	1																	
170	Shuanggui, Y., Jing, Y., and Shiyuan, D. 2011					1																		
171	Siddiqui, J. 2013.	1	1	1	1	1		1			1			1										
172	Silvis, J. 2015													1	1									
173	Sinha, M. 2011	1	1		1			1	1		1						1	1	1		1			
174	Smith and Perks,2010	1	1	1			1	1	1	1								1	1	1				
175	Smith, G.R. 2004				1	1		1	1	1	1			1					1					
176	Smith, E.E., and Perks, S. 2010																	1	1					
177	Stansberry, M. 2013.	1		1							1			1										
178	Starkey, R and Anderson, K. 2005.	1		1			1				1			1	1	1								

179	Steenkamp, G. 2011																1		1					
180	Stefan and Jan,2011		1			1										1			1					
181	Steward, R.A. ND.																					1		
182	Sthiannopkao, S and Wong, M.H. 2013.							1	1															
183	Talebi, M. and Way, T. 2009	1		1				1	1		1				1	1								
184	Tallon, P, and Scannell, R. 2007											1						1						
185	Tanskanen, P. 2013					1		1	1													1		
186	Terazono et al, 2006							1	1															
187	The Constitution of the Republic of South Africa (Act 106 of1996).				1	1													1					
188	The Editors, 2009	1					1		1		1				1	1				1				
189	Thibodeau, P. 2008														1	1								
190	Tocho, J. A., and Waema, T. M. 2013							1																
191	Tomlinson, B. 2010	1			1	1	1	1											1					
192	Trimi, S., and Park, S. 2013				1						1						1		1					
193	Uddin, M. and Rahman, A.A. 2012	1	1		1		1		1	1	1	1		1		1`			1	1				
194	UNEP. 2011																1	1	1		1			
195	Unhelkar, B. 2011	1			1			1			1													
196	United Nations Framework Convention on Climate Change (UNFCCC). 2009	1			1	1	1												1					
197	Ursery, S. 2010.							1										1						
198	Valanju, S.S. 2008										1	1			1									
199	Vereecken et al, 2010	1	1		1		1	1			1					1								
200	Vesilind, P.A. Heine, L. and Hendry, J. 2006																1	1	1					
201	Viaro, T.A., and Vaccaro, G.L.R. 2010.		1			1	1	1									1	1	1			1		
202	Victor, E.I. 2017.				1	1	1	1										1	1					

203	Vine, E and Hamrin, J. 2008	1		1	1		1				1					1								
204	Vykoukal, J, Wolf, M and Beck, R. 2009	1			1		1	1			1	1	1		1	1	1		1	1		1		
205	Waiti, Y, and Koo, C. ND		1		1			1											1					
206	Walker, G, and Cass, N. 2007			1			1									1								
207	Walker, M. 2017														1	1								
208	Wath, S.B., Dutt, P.S., and Chakrabarti. 2011				1			1																
209	Watson, M. 2009	1			1			1																
210	Welfens, P.J.J, and Lutz, C. 2012	1		1							1				1	1			1		1			
211	Whitley, J.A. 2001.							1																
212	Whitmarsh, L. 2009	1					1																	
213	Whitmarsh, L. 2009 (b)						1																	
214	Widjaja, N.D. Mariani, M. and Imam, K. 2011	1			1			1			1					1								
215	Widmer et al., 2005							1																
216	Williams et al., 2009				1			1	1															
217	Wunsch, C., Schmitt, R.W., and Baker, D.J. 2013	1	1		1	1	1																	
218	Yi, L, and Thomas, H.R. 2007.	1			1			1							1	1	1		1					
219	Young, W and Middlemiss, L. 2012.	1	1	1	1	1	1																	
220	Yunus et al.,2013	1			1						1			1										
221	Zhang, J and Liang, X. 2012	1	1		1		1		1		1				1				1	1	1			

APPENDIX 2: ETHICAL CLEARANCE

NORTH-WEST UNIVERSITY
YUNIBESITI YA BOKONE-BOPHIRIMA
NOORDWES-UNIVERSITEIT
MAFIKENG CAMPUS

Graduate School of Business and Government Leadership (GSB&GL)
Private Bag x 2046, Mmabatho
South Africa, 2735
Tel: 018-389 2437 Fax: 018-389 2335
Email: Gradschool@nwu.ac.za

To whom it may concern

It gives us great pleasure to inform you that the North West University Human Research Ethic`s Committee formally approved your research proposal for your PhD

Student Name	**Student No**	**Ethical Clearance No**
TP Moyo	20951671	NWU-00289-15-S9

The ethical clearance number indicated above is attached to your study. This serves as proof of approval to continue with your data collection and final completion.

We wish you all the success with your research

Research Office

APPENDIX 3: NWU COLLOQUIUM COMMITTEE

NORTH-WEST UNIVERSITY
MAFIKENG CAMPUS

Faculty of Commerce and Administration

Private Bag X2046, Mmabatho
South Africa, 2735
Tel: 018-389 2554 Fax: 018-389 2090
Web: www.nwu.ac.za

FHDRC5/2011

DOCTORAL COLLOQUIUM

The members of the colloquium appointed to attend the presentation of Moyo T on 30 April 2013

find it satisfactory and recommend that it be approved.

Type of presentation: 1st Proposal

Approval: Approval with revision subject to approval of Graduate School

Prof S Swanepoel
Executive Dean: Faculty of Commerce and Administration
Member of FHDRC

Prof T Pelser
Director: Graduate School of Business & Government Leadership
Member of FHDRC

Prof M Petersen
Research Professor of the Faculty Of Commerce and Administration
Member of FHDRC

Colloquium approval 30 April 2013

NORTH-WEST UNIVERSITY
MAFIKENG CAMPUS

Faculty of Commerce and Administration

Private Bag X2046, Mmabatho
South Africa, 2735
Tel: 018-389 2554 Fax: 018-389 2090
Web: www.nwu.ac.za

FHDRC5/2011

DOCTORAL COLLOQUIUM

The members of the colloquium appointed to attend the presentation of ~~Moyo~~ T P Moyo on 31 October 2013

find it satisfactory and recommend that it be approved.

Type of presentation: ~~Proposal~~ Theoretical Framework.

Approval:

Accepted	Recommendations	Referred back
✓		

Prof T Pelser
Director of the Graduate School of Business and GovernmentLeadership
Member of FHDRC

Prof J Mukuddem-Petersen
Professor at the Graduate School of Business and Government Leadership
Member of FHDRC

Prof M Petersen
Research Professor of the Faculty Of Commerce and Administration
Member of FHDRC

Colloquium approval 31 June 2013

NORTH-WEST UNIVERSITY
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FHDRC 26/10/2017

PHD COLLOQUIUM

The members of the colloquium appointed to attend the presentation of
T MOYO

on 26 OCTOBER 2017 find it satisfactory and recommend that it be approved.

Type of presentation: RESULTS/FINDINGS

Approval: Approved pending verification of previous studies

Prof B Tchereni
Research Professor:
Faculty of Economic and Management Sciences
Chairperson of the FHDRC

pp

Prof Y Khamfula
Professor: Faculty of Economic and Management Sciences
Member of the FHDRC

Prof JA Meyer
Professor: NWU School of Business and Governance
Member of the FHDRC

Colloquium approval letter

APPENDIX 4: INTERVIEW DEVELOPMENT MATRIX

Interview Development Matrix

	Types of Research Question	Question Nr.	Interview Development Matrix				
			Interview Question/ Statements	**Response Options**	**Data Type**	**Appropriate Data Measure**	**Appropriate Statistical Test**
Section 1	**Demographic Questions**	1.1	What is your gender?	Male - Female	Dichotomous	Nominal	Basic descriptive statistics, single group t test, the z proportions test the X^2 test. (Use demographic data to characterise your respondents)
		1.2	How long have you been working for your company?	1-2, 3-4, 5-6, 7-8, 9-10, 10+	Discrete	Ordinal	
		1.3	Is your involvement in your company from an IT or a Business perspective?	IT - Business	Dichotomous	Nominal	
		1.4	What type of post are you in at work?	Managerial - Non-Managerial	Dichotomous	Nominal	
		1.5	What are your qualifications	Matric - Degree	Dichotomous	Nominal	

Section 2	**Technical optimisation to address ecological issues Questions**	2.1 2.2 2.3 2.4	What are the benefits for green and eco-friendly system for your company? Has your company determined the ecological impact of IT equipments in order to manage carbon emission caused by IT use? Please explain Does your company ensure delivery of IT service and business value without compromising the environment? Please explain What method of technology does your company use to reduce/minimise/eliminate sensitive material of IT products that impact the environment?		Dichotomous Dichotomous Dichotomous Dichotomous	Nominal Nominal Nominal Nominal	Any member of the X^2 family or correlation tests, e.g., Phi co-efficient, the contingency coefficient and Cramer's V, the lambda co-efficient or the un-certainty coefficient (U) or the Pearson significance test. (Continuous data reveal attributes of whatever one studies, allow one to determine general trends and establish significant correlations = co-relation trends between two attributes) Chi-square test

		3.1	Is there a policy in existence to promote IT energy savings?	Strongly Agree -Agree-Disagree-Strongly Disagree	Continuum	Scalar (Likert Scale)	
		3.2	Have the managers and employees received appropriate training to reduce/minimise energy consumption caused by IT use?		Dichotomous	Nominal	
		3.3	Have the company analysed energy cost implications to promote energy efficiency?		Dichotomous	Nominal	Any member of the X^2 family or correlation tests, e.g., Phi co-efficient, the contingency coefficient and Cramer's V, the lambda co-efficient or the un-certainty coefficient (U) or the Pearson significance test.
Section 2	**Energy efficient and alternative technologies Questions**	3.4	What are the specific requirements/features that your company is looking for when buying new IT equipments (e.g. Do you buy high-powered that hit on energy (lasting longer) or low/green powered for low energy (replaced too soon)? Please explain		Dichotomous	Nominal	
		3.5	What steps did your company take to green its data centers to reduce operational costs?		Dichotomous	Nominal	(Continuous data reveal attributes of whatever one studies, allow one to determine general trends and establish significant correlations = co-relation trends between two attributes)
		3.6	Is reduction of power consumption a green or money issue for your company? Please explain		Dichotomous	Nominal	Chi-square test

Section 2	**E-waste management Questions**	4.1	Does your company purchase/look for energy saving devices that has been manufactured in an environmental fashion?	Strongly Agree -Agree-Disagree-Strongly Disagree	Continuum	Scalar (Likert Scale)	Any member of the X^2 family or correlation tests, e.g., Phi co-efficient, the contingency coefficient and Cramer's V, the lambda co-efficient or the un-certainty coefficient (U) or the Pearson significance test. (Continuous data reveal attributes of whatever one studies, allow one to determine general trends and establish significant correlations = co-relation trends between two attributes) Chi-square test
		4.2	Does your IT department consider the IT product life cycle and recycling issues upfront when buying computers and peripherals?		Dichotomous	Nominal	
		4.3	What is your company doing about e-waste?		Dichotomous	Nominal	
		4.4	How does your company dispose of electrical and electronic equipments that are obsolete without posing health and environmental hazards?		Discrete	Ordinal	
		4.5	Is your company upgrading hardware and software's and ensures recycling/refurbishing of IT equipments? Please explain		Dichotomous	Nominal	
		4.6	How does your company reuse or repair its IT equipments to increase the life span?		Discrete	Ordinal	

Section 2	**Legislations and regulations to address environmental issues Questions**	5.1	Are there business policies/regulations in place to address harmful environmental impact caused by IT use?	Strongly Agree -Agree-Disagree-Strongly Disagree	Continuum	Scalar (Likert Scale)	Any member of the X^2 family or correlation tests, e.g., Phi co-efficient, the contingency coefficient and Cramer's V, the lambda co-efficient or the un-certainty coefficient (U) or the Pearson significance test. (Continuous data reveal attributes of whatever one studies, allow one to determine general trends and establish significant correlations = co-relation trends between two attributes) Chi-square test
		5.2	Do you regard the company regulation/legislations sufficient to address environmental issues caused by IT use? Please explain		Dichotomous	Nominal	
		5.3	How does you company ensures compliance with relevant environmental laws and code of practice for IT operations?		Discrete	Ordinal	
		5.4	What systems/standards does your company utilise to minimise the environmental impact caused by IT use?		Dichotomous	Nominal	

Section 2	**Green IT framework Questions**	6.1	Is Green IT an investment for your company?		Dichotomous	Nominal	Any member of the X^2 family or correlation tests, e.g., Phi co-efficient, the contingency coefficient and Cramer's V, the lambda co-efficient or the un-certainty coefficient (U) or the Pearson significance test. (Continuous data reveal attributes of whatever one studies, allow one to determine general trends and establish significant correlations = co-relation trends between two attributes) Chi-square test
		6.2	What are the quick wins for implementing Green IT program for your company?		Dichotomous	Nominal	
		6.3	What are the factors that are driving the adoption of Green IT for your company?		Dichotomous	Nominal	
		6.4	What strategy does your company use to address growing business computing needs?		Dichotomous	Nominal	
		6.5	Are the costs for implementing Green IT affordable for your company? Please explain		Dichotomous	Nominal	
		6.6	Have the participation of all employees been ensured to make Green IT part of the company culture?		Dichotomous	Nominal	
		6.7	Do your IT personnel have sufficient knowledge of Green IT?		Dichotomous	Nominal	
		6.8	How does your company demonstrate return on investment (ROI) for Green IT implementation business value?		Discrete	Ordinal	
		6.9	Does your company vendor management fit into the business Green IT strategy for green technology solution?		Dichotomous	Nominal	
		6.10	What works and what does not work in your company Green IT strategy?		Dichotomous	Nominal	

APPENDIX 5 CODING BOOK

CODING BOOK

Column 1

What is your gender?

[1] = Male

[2] = Female

Column 2

How long have you been working for your company?

[1] = 1-2

[2] = 3-4

[3] = 5-6

[4] = 7-8

[5] = 9-10

[6] = 10+

Column 3

Is your involvement in your company from an IT or a Business perspective?

[1] = Business

[2] = IT

[3] = Both

Column 4

What type of post are you in at work?

[1] = Managerial

[2] = Non managerial

Column 5

What are your qualifications?

[1] Diploma

[2] Degree

Question 2.1 **Column**

What are the benefits for green and eco-friendly system for your company?

Response codes:

[1] = cost savings / reduction in costs

[2] = environmental benefits

[3] = human health benefits

[4] = CSR requirements fulfilled

[5] = no answer given

Question 2.2 **Column**

Has your company determined the ecological impact of IT equipments in order to manage carbon emission caused by IT use? Please explain

Response codes:

[1] = no / I don't think so

[2] = yes

[3] = unable to answer

[4] = question not answered

Question 2.3 Column

Does your company ensure delivery of IT service and business value without compromising the environment? Please explain

Response codes:

a) [1] strongly disagree

[2] disagree

[3] neutral

[4] agree

[5] strongly agree

Question 2.4 Column

What method of technology does your company use to reduce/minimise/eliminate sensitive material of IT products that impact the environment?

Response codes:

[1] = purchase green products that are environmentally friendly

[2] = use IM communication to reduce travel

[3] = ensure safe disposal of old equipment

[4] = ensure reduced printing

[5] = use of a UPS / generator

[6] = manually switch off the computers daily

[7] = do not believe the IT department causes environmental harm

[8] = use of bio plugs

Question 3.1 Column

Is there a policy in existence to promote IT energy savings?

Response codes:

[1] = Yes there is a policy

[2] = There is no policy

[3] = Unsure whether a policy exists or not

Question 3.2 Column

Have the managers and employees received appropriate training to reduce/minimise energy consumption caused by IT use?

Response codes:

[1] = definitely yes

[2] = yes I think so

[3] = unsure

[4] = no I don't think so

[5] = definitely no

Question 3.3 Column

Have the company analyzed energy cost implications to promote energy efficiency?

Response codes:

[1] = definitely yes

[2] = yes I think so

[3] = unsure

[4] = no I don't think so

[5] = definitely no

Question 3.4 Column

What are the specific requirements/features that your company is looking for when buying new IT equipments (e.g. Do you buy high-powered that hit on energy (lasting longer) or low/green powered for low energy (replaced too soon)? Please explain

Response codes:

[1] = task specific requirements e.g. mobility, memory, speed etc.

[2] = cost saving

[3] = no focus on green or energy saving in specs

[4] = extended warranty

[5] = quality and reliability

[6] = environmentally friendly / power usage / energy star

[7] = conform to international environmental standards

[8] = supplier being green means the company is also green

Question 3.5 Column

What steps did your company take to green its data centers to reduce operational costs?

Response codes:

[1] = unsure of steps

[2] = no steps being taken to change status quo

[3] = data centre purpose built to be environmentally friendly; buildings and equipment

[4] = servers are centralized

[5] = minimise unnecessary hardware

[6] = data centre management is outsourced

[7] = use of environmentally friendly fire retardants

[8] = use of modern virtual server's means less electricity is used.

Question 3.6 Column

Is reduction of power consumption a green or money issue for your company? Please explain

Response codes:

A:

1 = Green

2 = money

3 = both green and money considerations

Question 4.1 Column

Does your company purchase/look for energy saving devices that has been manufactured in an environmental fashion?

Response codes:

1 = strongly agree

2 = strongly disagree

Question 4.2 Column

Does your IT department consider the IT product life cycle and recycling issues upfront when buying computers and peripherals?

Response codes:

1 = Yes

2 = Probably yes

3 = To some extent

4 = Probably no

5 = No

Question 4.3 Column

What is your company doing about e-waste?

Response codes:

1 = use an outsourced recycling company

2 = redundant computers are auctioned / donated

3 = try to repair / upgrade before scrapping

4 = supplier responsible for disposal (leased items)

Question 4.4 Column

How does your company dispose of electrical and electronic equipments that are obsolete without posing health and environmental hazards?

Response codes:

1 = external company responsible for disposal

2 = obsolete equipment returned to supplier / traded in

3 = auction / donate working computers

4 = sold as scrap – no external recycling company used

5 = all components separated first

6 = batteries of laptops are collected by external company

Question 4.5 Column

Is your company upgrading hardware and software's and ensures recycling/refurbishing of IT equipments? Please explain

Response codes:

A: Hardware

1 = Yes upgraded

2 = No not upgraded

3 = Yes recycled

B: Software

1 = Yes upgraded

2 = No not upgraded

3 = Sometimes upgraded

4 = not answered

Question 4.6 Column

How does your company reuse or repair its IT equipments to increase the life span?

Response codes:

1 = regularly repair hardware to increase life span

2 = Only occasionally repair to increase life span outside of warranty

3 = do not try to increase life span beyond warranty

Question 5.1 Column

Are there business policies/regulations in place to address harmful environmental impact caused by IT use?

Response codes:

[1] = strongly agree

[2] = agree

[3] = neutral / unsure

[4] = disagree

[5] = strongly disagree

Question 5.2 Column

Do you regard the company regulation/legislations sufficient to address environmental issues caused by IT use? Please explain

Response codes:

A:

1 = Yes

2 = Unsure

3 = No

4 = Did not answer the question

B:

1 = lack of formal penalty system / enforceable regulations

2 = reliance on internal environmental department to protect environment

3 = few IT regulations linked to environment

4 = government policies are insufficient / government must be more proactive

5 = no reason given

6 = lack of awareness among staff / not publically available

Question 5.3 Column

How does you company ensures compliance with relevant environmental laws and code of practice for IT operations?

Response codes:

1 = Internal and external audits / ISO14001/ follow international standards

2 = interdepartmental support within organisation

3 = comply with all policies and procedures

4 = Provide training to employees on policies and procedures

5 = Currently not ensuring compliance

6 = Using recycled or refurbished parts to repair machines

Question 5.4 Column

What systems/standards does your company utilise to minimise the environmental impact caused by IT use?

Response codes:

1 = not sure of systems / no systems

2 = ISO 14001

3 = ISO 9001

4 = conform to relevant environmental policies

5 = audit energy consumption

6 = train / educate staff

7 = no need for systems as IT doesn’t cause environmental harm

Question 6.1 Column

Is Green IT an investment for your company?

Response codes:

1 = Yes it is an investment

2 = No it is not an investment

3 = Question not answered

Question 6.2 Column

What are the quick wins for implementing Green IT program for your company?

Response codes:

1 = Natural resource

2 = IT personnel

3 = Supporting green

4 = Engage business partners

5 = Management support

6 = Training

7 = Wireless

8 = IT policy

9 = Sensor installation

10 = Green plugs

11 = Printer reduction

Question 6.3 Column

What are the factors that are driving the adoption of Green IT for your company?

Response codes:

1 = environmental concerns, future generations, protect environment

2 = cost reduction

3 = improve company image, improved reputation

4 = competition with other companies

5 = no factors driving Green IT

Question 6.4 Column

What strategy does your company use to address growing business computing needs?

Response codes:

1 = research IT needs / report

2 = Budget

3 = only top management make decisions on company direction

4 = IT manager makes decisions on purchases

5 = Purchases must all be green compliant

6 = Aim to increase the IT equipment life span

7 = Reuse IT equipment as far as possible

8 = Purchase computers as needed

9 = Automatically replace every 3 years

10 = there is no strategy

Question 6.5 Column

Are the costs for implementing Green IT affordable for your company? Please explain

Response codes:

A:

1 = Yes

2 = No

3 = unsure

B

1 = initial costs high but cost effective in the long run

2 = sufficient budget

3 = benefits outweigh costs

4 = outsourcing reduces costs

5 = no difference in costs

6 = We're not going green

7 = results in energy and maintenance cost savings

8 = no reason given

Question 6.6 Column

Have the participation of all employees been ensured to make Green IT part of the company culture?

Response codes:

1 = Yes

2 = No

3 = To some extent

Question 6.7 Column

Do your IT personnel have sufficient knowledge of Green IT?

Response codes:

1 = Yes

2 = No

3 = Some staff do, to some extent

Question 6.8 Column

How does your company demonstrate return on investment (ROI) for Green IT implementation business value?

Response codes:

1 = increased collaboration

2 = decreased costs

3 = client' satisfaction

4 = reduced environmental impact

5 = system efficiency

6 = unsure if any ROI

Question 6.9 Column

Does your company vendor management fit into the business Green IT strategy for green technology solution?

Response codes:

1 = Yes

2 = No

3 = Unsure

Question 6.10 Column

What works and what does not work in your company Green IT strategy?

Response codes:

A: Does work

1 = reliable brand choice

2 = energy saving choices

3 = suppliers with good tech support

4 = cost effective suppliers

5 = fax to email services

6 = clear process and standards when replacing legacy equipment

7 = UPS and generator for server room

8 = Use of LCD / LED monitors

9 = outsourcing printing function

10 = buy cheaper local green products

B: Does not work

1 = frequent crashing of computers

2 = lack of research before purchasing

3 = lack of budget

4 = IT system does not match business requirements

5 = haphazard implementation or lack of defined strategy

6 = too much outsourcing of IT functions

7 = having to use outdated equipment for some applications

8 = initial startup costs for Green are high

9 = staff don’t adapt work habits without high level of supervision / staff inadequately trained

10 = reliance on paper copies not digital copies

11 = higher cost of repairs due to local brands being less durable

12 = relying too much on desktop PCs

APPENDIX 6: RESEARCH INTERVIEW GUIDE

NORTH-WEST UNIVERSITY
YUNIBESITI YA BOKONE-BOPHIRIMA
NOORDWES-UNIVERSITEIT
MAFIKENG CAMPUS

THE DEVELOPMENT OF A FRAMEWORK FOR GREEN INFORMATION TECHNOLOGY IMPLEMENTATION IN SOUTH AFRICAN ORGANISATIONS

For office use only: Respondent code_________________

VOLUNTARY INTERVIEWS FOR:

- ☐ Organisations' IT specialists
- ☐ Computer and IT technicians
- ☐ IT managers

Researcher: Tlhalefo Petterson Moyo

Supervisor: Professor Sam Lubbe

Co-supervisors: Professor Rembrandt Klopper and Jan Meyer

Faculty of Commerce and Administration North-West University

Note to respondents:

We would like to request 45-60 minutes of your time for interview questions. What you say in this interview will be treated private and confidential. No one will be able to trace your feedback and opinions back to you as a person in any means. You are most welcome to skip any question that you are not comfortable with and to ask questions that may seem unclear to you.

Discussion titles (approximately 45 to 60 minutes)

1. DEMOGRAPHICS (3 minutes)

1.1 What is your gender?

1.2 How long have you been working for your company?

1.3 Is your involvement in your company from an IT or a Business perspective?

1.4 What type of post are you in at work? Managerial/Non managerial

1.5 What are your qualifications?

2. TECHNICAL OPTIMISATION TO ADRESS ECOLOGICAL ISSUES (5 minutes)

2.1 What are the benefits for green and eco-friendly system for your company?

2.2 Has your company determined the ecological impact of IT equipments in order to manage carbon emission caused by IT use? Please explain

2.3 Does your company ensure delivery of IT service and business value without compromising the environment? Please explain

2.4 What method of technology does your company use to reduce/minimise/eliminate sensitive material of IT products that impact the environment?

3. ENERGY EFFICIENT AND ALTERNATIVE TECHNOLOGIES (7 minutes)

3.1 Is there a policy in existence to promote IT energy savings?

3.2 Have the managers and employees received appropriate training to reduce/minimise energy consumption caused by IT use?

3.3 Have the company analysed energy cost implications to promote energy efficiency?

3.4 What are the specific requirements/features that your company is looking for when buying new IT equipments (e.g. Do you buy high-powered that hit on energy (lasting longer) or low/green powered for low energy (replaced too soon)? Please explain

3.5 What steps did your company take to green its data centres to reduce operational costs?

4. E-WASTE MANAGEMENT (10 minutes)

4.1 Does your company purchase/look for energy saving devices that has been manufactured in an environmental fashion?

4.2 Does your IT department consider the IT product life cycle and recycling issues upfront when buying computers and peripherals?

4.3 What is your company doing about e-waste?

4.4 How does your company dispose of electrical and electronic equipments that are obsolete without posing health and environmental hazards?

4.5 Is your company upgrading hardware and software's and ensures recycling/refurbishing of IT equipments? Please explain

4.6 How does your company reuse or repair its IT equipments to increase the life span?

5. LEGISLATIONS AND REGULATIONS TO ADRESS ENVIRONMENTAL ISSUES (5 minutes)

5.1 Are there business policies/regulations in place to address harmful environmental impact caused by IT use?

5.2 Do you regard the company regulation/legislations sufficient to address environmental issues caused by IT use? Please explain

5.3 How does you company ensures compliance with relevant environmental laws and code of practice for IT operations?

5.4 What systems/standards does your company utilise to minimise the environmental impact caused by IT use?

6. GREEN IT FRAMEWORK (15 minutes)

6.1 Is Green IT an investment for your company?

6.2 What are the quick wins for implementing Green IT program for your company?

6.3 What are the factors that are driving the adoption of Green IT for your company?

6.4 What strategy does your company use to address growing business computing needs?

6.5 Are the costs for implementing Green IT affordable for your company? Please explain

6.6 Have the participation of all employees been ensured to make Green IT part of the company culture?

6.7 Do your IT personnel have sufficient knowledge of Green IT?

6.8 How does your company demonstrate return on investment (ROI) for Green IT implementation business value?

6.9 Does your company vendor management fit into the business Green IT strategy for green technology solution?

6.10 What works and what does not work in your company Green IT strategy?

APPENDIX 7: RESEARCH CONSENT FORM

For Official Use Only

Participant number/Initials

Research Interview Consent Form

Research project title: The Development of a Framework for Green Information Technology at South African Organisations

Research investigator: Tlhalefo Moyo

Research participants name:

The interview will take about one hour. The researcher does not anticipate that there are any risks associated with your participation, but you have the right to stop the interview or withdraw from research at any time.

Thank you for agreeing to be interviewed as part of the above research project. Ethical procedures for academic research undertaken by North West University requires that the interviewees explicitly agree to being interviewed and how the information contained in their will be used. This consent form is necessary for the researcher to ensure that you understand the purpose of your involvement and that you agree to the conditions of your participation. Therefore, the researcher requests you to read the accompanying information sheet and then sign this form to certify that you approve the following:

- The interview will be recorded and transcript will be produced
- You will be provided with the transcript and be given the opportunity to provide any factual errors
- The transcript of the interview will be analyzed by Tlhalefo Moyo as the research investigator
- Access to the interview transcript will be limited to Tlhalefo Moyo and academic colleagues and researchers with whom collaboration will be made as part of the research process
- Any summary interview content, or direct quotation from the interview, that are made available through academic publication or other academic outlets will be kept anonymous so that you cannot be identified, and care will be taken to ensure that other information in the interview that could identify yourself is not revealed
- The actual recording will only be kept for a year and be destroyed
- Any variation of the conditions above will only occur with your further explicit approval

Quotation agreement

I also understand that my words may be quoted directly. With regards to being quoted, please tick next to any statements that you agree with:

	I wish to review the notes, transcripts or other data collected during the research pertaining to my participation.
	I agree to be quoted directly.
	I agree to be quoted directly if my name is no published and a made up name (pseudonym) is used.
	I agree that the researchers may publish documents that contain quotations by me.

All or part of the content of your interview may be used;

- In academic papers, policy papers or news articles
- On other feedback events
- In an archive of the project as noted above

By signing this form I agree that:

1. I have read the Information sheet;
2. I understand my participation is voluntary in this research project. I understand that I don't have to take part and I can withdraw at any time without giving any reason and without there being any negative consequences. In addition, should I not wish to answer any particular question or questions, I am free to decline;
3. I understand that my responses will be kept strictly confidential. I understand that my name will not be linked with research materials, and will not be identified or identifiable in the report or reports that result from the research;
4. I agree for this interview to be tape-recorded. I understand that the audio recording made of this interview will be used only for analysis and that extracts from the interview, from which I

would not be personally identified, may be used in any conference presentation, report or journal article developed as a result of the research. I understand that no other use will be made of the recording without my written permission, and that no one outside the research team will be allowed access to the original recording;

5. I don’t expect to receive any benefit or payment for my participation;
6. I can request a copy of the transcript of my interview and may make edits where necessary to ensure the effectiveness of any agreement made about confidentiality;
7. I have been able to ask any questions I might have and I understand that I am free to contact the researcher with any questions I may have in the future;
8. I agree that my anonymized data will be kept for future research purposes such as publications related to this study after completion of this study.

Printed name

Participant Signature Date:

Researcher signature Date:

Contact information

This research has been reviewed and approved by North West University Research Ethics Committee. Should you have any questions or concerns about this study, please contact:

Tlhalefo Moyo

Cellphone numbers: 083 629 0331

E-mail: tlhalefomoyo@yahoo.com

You can also contact the researcher’s supervisor

Prof Sam Lubbe

Email: sam.lubbe@gmail.com

APPENDIX 8: LETTER REQUESTING PERMISSION

NORTH-WEST UNIVERSITY
YUNIBESITI YA BOKONE-BOPHIRIMA
NOORDWES-UNIVERSITEIT
MAFIKENG CAMPUS

45 Piet Retief Boulevard

SE7

Vanderbijlpark

1911

Attention: Human Resource Department

REQUEST FOR PERMISSION TO CONDUCT RESEARCH

My name is Tlhalefo Moyo, and I am a registered PhD student at North West University in Mafikeng. I hereby seek your consent to interview the Information Technology (IT) technicians, IT managers and financial managers/Chief financial officers. The ethical clearance has been granted by the Graduate School of Business and Governmental Leadership committee at North West University.

The research I wish to conduct for my Doctoral thesis involves "The Development of a Framework for Green Information Technology at South African Organisations". This study is conducted under the supervision of Prof Sam Lubbe (University of Zululand) and co-supervisors Prof Rembrandt Klopper (University of KwaZulu-Natal) and Jan Meyer (North West University). All the information will be treated with strict confidentiality and the name of the company will not be revealed. Furthermore, all the information will be exclusive for research purpose and no personal or company names or any identifying information will be identified.

Upon completion of the study, I undertake to provide the company with a bound copy of the full research report. If you require any further information, please do not hesitate to contact me on this number: 083 629 0331 or by email at tlhalefomoyo@yahoo.com . I hope that my request will be considered.

Yours sincerely,

Tlhalefo Moyo

APPENDIX 5: CERTIFICATE OF EDITING

P. O BOX 5826
Mmabatho
2735

16th Nov 2017

CERTIFICATE OF LANGUAGE EDITING

TITLE OF THESIS

The development of a framework for Green Information Technology implementation in South African Organisations.

SUBMITTED BY

Tlhalefo Petterson Moyo

(Student No. 20951671)

FOR THE DEGREE OF

Doctor of Philosophy
(Business Management and Administration)

IN THE

Faculty of commerce and Administration

North-West University
Mafikeng Campus

Has been edited for language and other technical details by:

Prof. S. A. Awudetsey

Prof S A Awudetsey
0722371390

P. O BOX 5826
Mmabatho
2735

18th April 2018

CERTIFICATE OF LANGUAGE EDITING

TITLE OF THESIS

The development of a framework for Green Information Technology implementation in South African Organisations.

SUBMITTED BY

Tlhalefo Petterson Moyo

(Student No. 20951671)

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Prof S A Awudetsey
0722371390