Explicating the Enabling Capabilities of Green IS: A Management Framework for South African Banks

G.R. Howard

23072652

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Promoter: Professor S. Lubbe
Co-promoter: Professor M. Huisman

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Declaration Statement

With the signature below, I, Grant Royd Howard, hereby declare that the work that I present in this thesis is based on my own research, and that I have not submitted this thesis to any other institution of higher education to obtain an academic qualification.

Grant Royd Howard (23072652) 	25 March 2014
Full name and student number	Date

Abstract

Environmental resource depletion and degradation threatens the well-being and possibly the long-term survival of the human race. This research addresses environmental resource depletion and degradation from an Information Systems (IS) perspective within South African banking organisations. Prior research exposes how IS have enabled and transformed organisations in many important ways. However, prior research does not explicate the enabling and transforming capabilities of Green IS for environmental sustainability; this is the research problem. In order to address this research problem, the objective of the research was to develop and verify an empirical Green IS framework that explicates the enabling and transforming capabilities of Green IS for environmental sustainability. The thesis is empirical and employs a mixed methods approach, involving the grounded theory method and content and correspondence analysis, the focus group method, and member checking. The thesis explicates, by way of a management framework, the enabling capabilities of Green IS for environmental sustainability, within South African banking organisations. This is an original contribution to the academic body of knowledge. The evidence indicates that the enabling capability of Green IS is prevalent while there is no evidence of a transforming capability. In addition, the thesis elucidates the concept of environmental sustainability exposing the importance of strong environmental sustainability and contrasting it with other contemporary, comparative concepts in the literature. The framework provides management with focal points for environmental sustainability by explicating the salient concepts and their interrelationships.

Keywords (in alphabetical order):
Content and correspondence analysis, environmental sustainability, focus group, Green computing, Green Information Systems (Green IS), Green Information Technology (Green IT), Green IS framework, grounded theory, member checking.

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List of Abbreviations (appearing more than once)

- BSc - Bachelor of Science
- BSC - Balanced scorecard
- CA - Corporate Bank A
- CB - Corporate Bank B
- CC - Corporate Bank C
- CD - Corporate Bank D
- CE - Corporate Bank E
- CEC - Corporate environmental citizenship
- CERES - Coalition for Environmentally Responsible Economies
- CLSC - Closed loop supply chains
- CS - Corporate sustainability
- CSD - Corporate sustainable development
- CSR - Corporate social responsibility
- EDQ - Environmental data quality
- EFT - Environmental-financial translation
- EMAS - Eco-Management and Audit Scheme
- EMS - Environmental management system
- ESR - Environmental social responsibility
- EU - European Union
- G-readiness - Green IT readiness
- GDP - Gross domestic product
- GHG - Greenhouse gas
- GIEBPE - Green IS enabled business process efficiencies
- GIECFM - Green IS enabled carbon footprint management
- GIEEABA - Green IS enabled environmental analysis
- GIEEDM - Green IS enabled environmental data management
- GIEEII - Green IS enabled environmental information impartment
- GIEERM - Green IS enabled environmental risk management
- GII - Green IS integration
- GRI - Global Reporting Initiative
- GSCM - Green supply chain management
- GSCM/PMS - GSCM performance management system

- IA - Industry Body
- ICT - Information and Communication Technology
- IOS - Interorganisational systems
- IS - Information Systems
- ISO - International Organization for Standardization
- IT - Information Technology
- JSE - Johannesburg Stock Exchange
- MBA - Master of Business Administration
- MSc - Master of Science
- NRBV - Natural-resource-based view
- NWU - North-West University
- PhD - Doctor of Philosophy
- RB - Retail Bank
- RBV - Resource-based view
- ROI - Return on investment
- SA - South Africa
- SEST - Strong environmental sustainability transformation
- SIGGreen - Green IS special interest group
- SME - Small and medium enterprise
- SV - Software Vendor
- UNEP - United Nations Environment Programme
- UNFCCC - United Nations Framework Convention on Climate Change
- UNISA - University of South Africa
- US - United States
- USA - United States of America
- WEST - Weak environmental sustainability transformation
- WRI - World Resources Institute

Chapter 1: Foundation of the Research

1.1 Chapter introduction

Chapter One exposes the threat of environmental resource depletion and degradation. Information Systems (IS) are presented as critical enablers and transformers of organisations, and subsequently, Green IS as powerful means to enable and transform organisations for environmental sustainability.

The goal of the chapter is to lay the foundation for the thesis through an explanation of what the research is about, for whom it is relevant, where it took place, how it was done, and why it was conducted. In order to achieve this goal, the following objectives must be fulfilled, namely introduce the research, expound the research problem, the research objective, and the research questions, justify the research in the context of relevant, contemporary research, and present the research design.

Chapter One continues with a glossary of key terms followed by the background and context of the research. Thereafter, the research problem definition, research objective, and research questions are provided. Next, the research design is summarised and the scope, assumptions, and delineations are put forward. Subsequently, the significance and rationale are detailed. The chapter closes with a high-level layout of the thesis, a summary, and conclusions.

1.2 Glossary of key terms

Anthropogenic – Anthropogenic is an adjective describing phenomena that result from human activity (IPCC, n.d.).

Climate change – Climate change refers to measurable and major changes in the Earth's climate over extended periods, for example major changes in temperature, rainfall, snow, or wind patterns over periods longer than ten years (US EPA, 2009).

Enabling capability – This is the intangible quality or characteristic that provides the means for achieving specific objectives (Dictionary.Com, n.d.).

Environment – The environment in the context of this thesis refers to the natural surroundings in which an organisation operates; or to the natural or ecological capital, which includes soil, water, atmosphere, land, fauna, flora, and habitats such as forests and wetlands (Ekins, Simon, Deutsch, Folke, & De Groot, 2003; Goodland, 1995; GDRC, n.d.). Natural capital has the capability to perform unique environmental functions, being the source function, the sink function, the life support function including climate stability, and the amenity services function including open natural areas (Ekins *et al.*, 2003).

Environmental resource depletion and degradation – This denotes the reduced capacity of the environment to sustain human life and welfare (UNISDR, 2009; Glavic & Lukman, 2007).

Framework – A framework explicates concepts and the concept interrelationships that are important to a particular problem, with the purpose of enabling understanding and effective action for both researchers and practitioners (Schwarz, Mehta, Johnson, & Chin, 2007; Gregor, 2006; Sekaran, 2003; Porter, Argyres, & McGahan, 2002). A framework encapsulates the pertinent and significant theory relating to a specific problem or a specific phenomenon, in an organised, comprehensive, unifying, parsimonious, and useful depiction (Schwarz *et al.*, 2007; Gregor, 2006; Sekaran, 2003; Porter *et al.*, 2002).

Global warming – Global warming is a type of climate change characterised by an average increase in the temperature of the atmosphere near the Earth's surface (US EPA, 2009).

Green – The term 'green' is a general term used to describe solutions to environmental resource depletion and degradation (Dictionary.Com, n.d.; Ijab, Molla, Kassahun, & Teoh, 2010).

Greenhouse effect – The greenhouse effect occurs when greenhouse gases reflect and trap heat in the atmosphere near the Earth's surface, resulting in global warming (UNFCCC, n.d.).

Greenhouse gas (GHG) – Greenhouse gases (GHGs) are specific natural or anthropogenic gases that form part of the Earth's atmosphere and cause the greenhouse effect (IPCC, n.d.). GHGs include water vapour (H_2O), carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrochlorofluorocarbons (HCFCs), ozone (O_3), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF_6) (UNFCCC, n.d.).

Green IS – Green IS are the Information Systems (IS) for environmental sustainability (Watson, Boudreau, & Chen, 2010; Lee, 2004; Watson, Boudreau, Chen, & Huber, 2008). Within an organisational context, Green IS encompass Green Information Technology (IT), since IT's environmental impacts form part of the overall organisational environmental resource depletion and degradation (Watson, Boudreau, & Chen, 2010). Green IS exceed Green IT by addressing the extensive problem of overall organisational environmental resource depletion and degradation (Watson *et al.*, 2008).

Green IT – Green IT is the application of environmental sustainability specifically throughout the Information Technology (IT) lifecycle (Molla, Pittayachawan, & Corbitt, 2009; Murugesan, 2008), with a focus on e-waste minimisation and energy efficiency maximisation (Watson *et al.*, 2008).

Information and Communication Technology (ICT) – This is IT inclusive of telephony, broadcast media, and audio and video processing and transmission (Dictionary.Com, n.d.).

Information Systems (IS) – Information Systems are the systems that emerge from the interaction between people, processes, and IT, in support of individual, organisational, or societal goals

(Watson *et al.*, 2010; Lee, 2004). IS gather, manipulate, analyse, store, and distribute information for specific organisational objectives, and are comprised of people, procedures, networks, data, software, and hardware (Turban & Volonino, 2012).

Information Systems (IS) research – Information Systems research investigates the phenomena that emerge from the interaction of technological and social systems (Lee, 2001).

Information Technology (IT) – Information Technology concerns the technological systems comprising physical devices and associated software that are used to retrieve, transmit, process, or store data and information (Watson *et al.*, 2008).

Non-renewable resource – Environmental resources that cannot be regenerated by the environment within a practical time frame; these include fossil fuels such as oil, coal, and gas (Yourdictionary.Com, n.d.).

Organisation – An organisation is a social system that is structured and managed to attain collective objectives; it also affects and is affected by the environment outside of its boundaries (BusinessDictionary.Com, n.d.).

Renewable resource – Environmental resources that the environment can regenerate within a practical time frame (Investopedia.Com, n.d.); these include resources like fish, cattle, poultry, vegetation, timber and paper, oxygen, most water resources, and wind and solar energy.

Transforming capability – This is the intangible quality or characteristic that causes or drives radical change (Dictionary.Com, n.d.).

Waste emissions – These relate to a wide variety of waste types that are released into the environment, including scope 1, 2, and 3 carbon emissions, organic waste (Landlearn NSW, n.d.), refuse, e-waste, and waste products from manufacturing processes.

1.3 Background and context

People are completely dependent on the Earth's natural environment for their existence. Despite this vital dependency, human activities are depleting and degrading the Earth's environmental resources; this threatens the well-being of all people and possibly the long-term survival of the human race (Elliot, 2011; Melville, 2010; Watson, Boudreau, & Chen, 2010; UNEP, 2010b; UNEP, 2011a; Millennium Ecosystem Assessment, 2005b).

Environmental resource depletion and degradation has many symptoms, and a particularly dire one is anthropogenic climate change (IPCC, 2013), including global warming (Elliot, 2011; Melville, 2010; Watson, Boudreau, & Chen, 2010; Molla, 2008; The Copenhagen Diagnosis, 2009; Easterbrook, 2010; Hansen, Ruedy, Sato, & Lo, 2010; Stern, 2006). This research acknowledges that there are varied arguments against the claims that climate change, including global warming, is a problem and/or is caused by human activity. However, there is extensive

peer-reviewed scientific evidence and proven scientific community consensus for the claims that climate change, including global warming, is a problem and is caused by human activity (Weart, 2011; Anderegg, Prall, Harold, & Schneider, 2010; Oreskes, 2004). Even if doubt persists that climate change, including global warming, is a problem and/or is caused by human activity, there is little doubt that climate change is a permanent business reality for organisations; indeed it is both a challenge and an opportunity (Hoffman & Woody, 2008). Other similarly dire symptoms of environmental resource depletion and degradation include deforestation, loss of biodiversity, water pollution and water scarcity, air pollution, and depleted fish stocks, all of which are exacerbated by a very large and growing global human population (UNEP, 2011b; UN, 2011; UNEP, 2007; Bartlett, 1994).

In response, the concept of environmental sustainability addresses environmental resource depletion and degradation (UN Millennium Project, 2005; UNEP, 2007; Elliot, 2011). Environmental sustainability is the maintenance of the environment so that the environment can support human life and well-being into the very long term (Goodland, 1995). Importantly, history provides evidence that continued environmental resource depletion and degradation with the expectation that technological innovation will eliminate all the consequential negative impacts on human well-being and survival is not feasible (Goodland, Daly, & Kellenberg, 1994). Therefore, environmental sustainability is imperative. Significantly, there are various degrees of environmental sustainability, namely very weak, weak, strong, and very strong or absurdly strong, and of these, the overwhelming scientific consensus on environmental resource depletion and degradation necessitates strong environmental sustainability (Ekins *et al.*, 2003).

The unit of analysis and focus of the research is the organisation. Organisations are a prominent and core feature of society and the engines of the world's economies (Watson & Boudreau, 2011; Melville, 2010). Organisations continue to deplete and degrade environmental resources, and externalise the associated costs for profit and competitiveness (Perrow, 1997; Hoffman, 2010). This environmental resource depletion and degradation occurs during the extraction of vast amounts of natural resources, the transformation of these natural resources into products, and the disposal of these products and their associated waste back into the environment (Watson & Boudreau, 2011; Shrivastava, 1995). Exposure of the environmental resource depletion and degradation is putting organisations under increasing pressure to demonstrate environmental sustainability (Millennium Ecosystem Assessment, 2005a). Nevertheless, global environmental sustainability is regarded as the responsibility of organisations because they possess the substantial means in the form of resources, knowledge, technology, global reach, power, motivation, and capacity for innovation and change (Elliot, 2011; Laszlo & Laugel, 2000; Hart,

1997; Shrivastava, 1995). Indeed, organisations are where the greatest environmental sustainability returns exist (The Climate Group, 2008).

In particular, banking organisations have a pivotal role in the modern economy (National Treasury, 2011; Ndako, 2010), their functions influence entire economies including economies' efficacy, performance (Falkena *et al.*, 2004), and growth (Acaravci, Ozturk, & Acaravci, 2009; Cetorelli & Gambera, 2001; Hassan, Sanchez, & Yu, 2011). This was especially evident in the 2007 to 2009 global financial crisis where international banks transmitted a global recession (Kollmann, Enders, & Müller, 2011). Importantly, banking organisations influence extensive environmental impact through their investment and financing activities (Ceres, 2009; Ceres, 2008; Richardson, 2004; BASA, 2011; EP, 2012). Thus, focusing on the banking sector in this research offers an opportunity to address widespread environmental resource depletion and degradation (Allenby, Compton, & Richards, 2001).

Specifically, IS have been instrumental in transforming organisations over the past five decades (Watson & Boudreau, 2011; Melville, 2010; Watson *et al.*, 2008; Agarwal & Lucas Jr, 2005; Moreton, 1995; Gurbaxani & Whang, 1991; Drucker, 1988). In addition, IS have fulfilled a vital enabling role in organisations (Watson & Boudreau, 2011; Porter, 2001; Johnston & Vitale, 1988; Porter & Millar, 1985), which has increased their effectiveness and efficiency (Hevner, March, Park, & Ram, 2004). Notably, the information component of IS is critical to organisations (Moody & Walsh, 1999; Glazer, 1993). Therefore, IS present powerful means to address the environmental resource depletion and degradation attributable to organisations (Melville, 2010). Indeed, the study of IS within organisations is a primary focus of IS research (Sidorova, Evangelopoulos, Valacich, & Ramakrishnan, 2008).

Notably, a component of IS is Information Technology (IT) (Watson *et al.*, 2008), and IT's proliferation and pervasiveness has resulted in a substantial environmental impact (Corbett, 2010; Molla, Pittayachawan, & Corbitt, 2009; Murugesan, 2008; Murugesan, 2010; Prattipati, 2010). This impact occurs throughout the IT life cycle, during production, use, and disposal. During production, IT consumes electricity, raw materials, chemicals, and water, and generates hazardous waste.

During use, IT consumes electricity that is generated primarily by fossil-fuel burning power plants, such as coal burning power plants. These power plants emit GHGs, such as carbon dioxide (CO_2). GHGs cause climate change, including global warming, and CO_2 is the leading contributor (IPCC, 2007). During 2005, in the United States of America (USA), the total electricity used by IT servers including cooling and auxiliary infrastructure was 1.2% of the USA's total electricity consumption (Koomey, 2007). During 2007, IT including

telecommunication and broadcast media contributed 3.9% to global electricity consumption (Malmodin, Moberg, Lundén, Finnveden, & Lövehagen, 2010).

During disposal, IT is dumped into landfills, where it becomes toxic electronic waste (e-waste) and contaminates the earth and water (Murugesan, 2008). Huge consumer demand for IT products and high IT product obsolescence rates result in the creation of approximately 20 to 50 million tons of e-waste per annum globally (UNEP, 2005).

The aforementioned scale and severity of IT's environmental impacts have resulted in Green IT initiatives (Murugesan, 2008). Green IT is the application of environmental sustainability throughout the IT lifecycle (Molla, Pittayachawan, & Corbitt, 2009; Murugesan, 2008), with a focus on e-waste minimisation and energy efficiency maximisation (Watson *et al.*, 2008).

While it is important to address the environmental resource depletion and degradation attributable to IT alone, it is equally important to address the more extensive environmental resource depletion and degradation attributable to all organisational activities (The Climate Group, 2008). Here, the enabling and transforming capabilities of IS present solutions (Melville, 2010). IS in this context are termed Green IS where Green IS are the systems that emerge from the interaction between social systems that comprise people, and technical systems that comprise IT, for environmental sustainability (Watson, Boudreau, & Chen, 2010; Lee, 2004; Watson *et al.*, 2008). Green IS encompass Green IT since IT's environmental impact forms part of the environmental resource depletion and degradation attributable to all organisational activities (Watson, Boudreau, & Chen, 2010), and Green IS exceed Green IT by addressing the extensive problem of environmental resource depletion and degradation attributable to all organisational activities (Watson *et al.*, 2008; Molla & Abareshi, 2011; Dedrick, 2010; Iacobelli, Olson, & Merhout, 2010).

In addition, Green IS facilitate the systematisation of environmental information (Allenby *et al.*, 2001), which is regarded as vital in reversing environmental resource depletion and degradation (UNEP, 2010a; Watson, Boudreau, & Chen, 2010; Dumont & Brison-Chraniotis, 2008). Further, the literature confirms that it is at the point where technological systems and the social systems interact that IS-based environmental sustainability solutions appear unbounded (Elliot, 2007), and it is the enabling and transforming effects of Green IS that are now the challenge for IS research (Butler, 2011b).

In this regard, banking organisations are at an advantage because they use IS extensively and have undergone technology-based transformations (Molla, Cooper, & Pittayachawan, 2009; Elliot, 2006; Berger, 2003). In addition, banking organisations' investment and financing decisions are dependent on information, and this is the domain of IS (Allenby *et al.*, 2001).

In summary, organisations are prominent social structures and collectively they have a significant impact on the environment. As such, they are critical for promoting environmental sustainability (Melville, 2010; Watson *et al.*, 2008; Elliot, 2011). Furthermore, IS are indispensable to organisations and present considerable potential for enabling and transforming organisations for environmental sustainability. This research addresses the problem of environmental resource depletion and degradation attributable to all organisational activities from the perspective of IS, namely Green IS. In particular, this research focuses on banking organisations because they influence extensive environmental impact through their investment and financing activities.

1.4 Problem definition

Prior research exposes how IS have significantly enabled and transformed organisations in many important ways (Watson, Boudreau, & Chen, 2010; Tambe & Hitt, 2012; Pitt, Parent, Junglas, Chan, & Spyropoulou, 2011; Kuo, 2010; Mithas, Ramasubbu, & Sambamurthy, 2011; Besson & Rowe, 2012). However, it does not explicate the enabling and transforming capabilities of Green IS for environmental sustainability; this is the research problem. The literature is not conclusive about how to leverage IS for environmental sustainability (Meacham, Toms, Green Jr, & Bhadauria, 2013; Melville, 2010; Watson, Boudreau, & Chen, 2010). Furthermore, there are numerous Green IS and related frameworks in the literature and while each framework has a particular and significant perspective, none specifically explicates the enabling and transforming capabilities of Green IS for environmental sustainability (Howard & Lubbe, 2012).

1.5 Research objectives

In order to address the research problem presented in subsection 1.4, the main objective of this research was to develop and verify an empirical Green IS framework that explicates the enabling and transforming capabilities of Green IS for environmental sustainability. In doing so, this thesis makes an original contribution to the academic body of knowledge. In support, the literature indicates that frameworks are highly beneficial for managers (Porter *et al.*, 2002; Branzei, Ursacki-Bryant, Vertinsky, & Zhang, 2004) and the development of green frameworks provides direction, illustrates the evolutionary paths, and depicts the necessary changes (Hart, 1997). In addition, green frameworks ensure that organisations respond to environmental sustainability in a proactive manner, prevent wasted resources and poor returns on investment, and present opportunities for competitiveness and success (Molla *et al.*, 2008). The main objective of this research was divided into two sub-objectives:

- The first sub-objective was to develop a Green IS framework using the grounded theory method and content and correspondence analysis; and
- The second sub-objective was to verify the developed Green IS framework using the focus group method and member checking.

1.6 Research questions

Corresponding to the research problem and research objective, there are three research questions, these are:

1 What is environmental sustainability and why is it important?

2 How do the enabling and transforming capabilities of Green IS manifest and relate to environmental sustainability?

3 According to experts, does the Green IS framework successfully capture the essential Green IS concepts and interrelationships to be relevant for environmental sustainability?

1.7 Research design

The term 'research design' is used in this research to refer to a high-level outline of the research methodology. In comparison, the term 'research methodology' is used in this research to refer to the comprehensive details about how the research achieved its research objective and answered its research questions. The research design followed a mixed methods approach in order to accomplish the objective. Essentially, a mixed methods approach mitigates the limitations of a single research approach, benefits from different epistemological perspectives, has greater applicability to complex organisational contexts, and makes a more significant contribution to scholarly and practical knowledge (Davison & Martinsons, 2011; Jogulu & Pansiri, 2011; Rocco, Bliss, Gallagher, & Pérez-Prado, 2003; Gable, 1994; Kaplan & Duchon, 1988).

Firstly, the grounded theory method and content and correspondence analysis involved exploration and the analysis of qualitative and quantitative data from banking organisations and related in South Africa. This resulted in the development of the Green IS framework. Thereafter, the focus group method and member checking involved verification and the collection of qualitative data from experts in South Africa. This resulted in the verification of the Green IS framework.

1.8 Scope, assumptions, and delineations

This research took place in South Africa, which can be regarded as a developing country (UNDP, n.d.), and developing countries are the most vulnerable to environmental resource depletion and degradation (UNFCCC, 2007). It is noted that focusing on a single industrial sector, such as banking, can provide greater insight than a more dispersed focus covering a wide

variety of economic sectors (Molla, Cooper, & Pittayachawan, 2011; Chen, Watson, Boudreau, & Karahanna, 2010).

1.9 Significance and rationale

Environmental resource depletion and degradation threatens the well-being of all people and possibly the long-term survival of the human race (Elliot, 2011; Melville, 2010; Watson, Boudreau, & Chen, 2010; UNEP, 2010b; UNEP, 2011a; Millennium Ecosystem Assessment, 2005b). Thus, research that addresses environmental resource depletion and degradation is valuable for all people.

Furthermore, the research was motivated by explicit academic calls for research at the intersection of IS, organisations, and environmental sustainability. This is the transdisciplinary domain of Green IS research (Benitez-Amado & Walczuch, 2012; Chen, Watson, Boudreau, & Karahanna, 2010; Kallio & Nordberg, 2006). The majority of these calls are from leading research journals (Benitez-Amado & Walczuch, 2012; Malhotra, Melville, & Watson, 2011; Elliot, 2011; Jenkin, Webster, & McShane, 2011; Dao, Langella, & Carbo, 2011; Watson, Boudreau, & Chen, 2010; Melville, 2010; Malhotra, Melville, & Watson, 2013). Further calls have been made in leading IS conference proceedings (Ijab *et al.*, 2010; Elliot & Binney, 2008; Elliot, 2007).

Other calls indicate that environmental sustainability in organisations has been an unresolved research problem for many years (Shrivastava, 1995) and that Green IS research is required in South Africa (Petzer, McGibbon, & Brown, 2011). Importantly, this research aligns closely with the primary goal of the United Nations Framework Convention on Climate Change (UNFCCC), which is to decrease environmental resource depletion and degradation (UNFCCC, 2009).

Therefore, the development and verification of the framework in this research is necessary and justified. Furthermore, a verified framework is one that the ultimate beneficiaries, namely the organisations, substantiate as relevant. This addresses "so what?" and "who cares?" questions, by providing evidence that the research has made a significant and original contribution to the academic body of knowledge and has furthered environmental sustainability. In addition, the mixed methods approach contributes to the academic body of IS methodological knowledge by providing methodological insight to inform future research.

1.10 Layout of the thesis

The thesis is composed of seven chapters in sequential order. The goal of Chapter One was to lay the foundation for the thesis through an explanation of what the research is about, for whom it is relevant, where it took place, how it was done, and why it was conducted. The goal of Chapter Two is to develop a theoretical foundation for the research by way of a systematic literature

review. In addition, an important sub-objective of Chapter Two is to answer the first research question, namely: what is environmental sustainability and why is it important? The goal of Chapter Three is to define and justify the research methodology for the research. The goal of Chapter Four is to expose the implemented grounded theory process as a competent base for the framework development and corroboration in Chapter Five. The goal of Chapter Five is to answer the second research question, namely: how do the enabling and transforming capabilities of Green IS manifest and relate to environmental sustainability? The goal of Chapter Six is to answer the third research question, namely: according to experts, does the Green IS framework successfully capture the essential Green IS concepts and interrelationships to be relevant for environmental sustainability? The goal of Chapter Seven is to present the outcomes or conclusions of the research.

1.11 Chapter summary and conclusions

Chapter One contained an explanation of the problem of environmental resource depletion and degradation, and the potential solution of IS within organisations was elucidated. The chapter objectives have been fulfilled by introducing the research in subsections 1.2 and 1.3, expounding the research problem, research objective, and research questions in subsections 1.4, 1.5, and 1.6, justifying the research in the context of relevant, contemporary research in subsections 1.3, 1.8, and 1.9, and presenting the research design in subsection 1.7. Therefore, the goal of Chapter One has been achieved, i.e. laying the foundation for the thesis by introducing what the research is about, for whom it is relevant, where it took place, how it was done, and why it was conducted.

In conclusion, the threat of environmental resource depletion and degradation is evident in the light of peer-reviewed, scientific evidence. Organisations have the power and the resources to exacerbate or mitigate environmental resource depletion and degradation. IS are critical enablers and transformers of organisations, and subsequently, Green IS present powerful means to enable and transform organisations for environmental sustainability. Thus, it is necessary to develop and verify a Green IS framework that empirically explicates the enabling and transforming capabilities of Green IS for environmental sustainability.

This research has substantial value for academics as it furthers the academic body of knowledge in the IS field by explicating the enabling and transforming capabilities of Green IS for environmental sustainability, through the application of an appropriate mixed methods approach. This research also has substantial value for industry and organisations, by offering definitive guidance and insight for leveraging the enabling and transforming capabilities of IS for environmental sustainability.

Chapter Two provides a systematic literature review and sets this research in the context of relevant research. The relevant concepts emerging from the literature are analysed, and a basis is provided for demonstrating the original contribution to the academic body of knowledge. The chapter culminates in a sensitising theoretical framework.

Chapter 2: Systematic Literature Review

2.1 Chapter introduction

Chapter One exposed the threat of environmental resource depletion and degradation, showed that organisations have the power and the resources to exacerbate or mitigate this threat, and presented the argument that Green IS are critical enablers and transformers of organisations for environmental sustainability. Furthermore, developing and verifying an empirical Green IS framework to address organisational environmental resource depletion and degradation was justified in Chapter One.

Chapter Two follows Chapter One with a systematic literature review. Apart from this being a mandatory part of any research project (Oates, 2006; Mouton, 2001), the goal of Chapter Two is to develop a theoretical foundation for the research by way of a systematic literature review. This goal is achieved through fulfilment of the following objectives: detail the systematic literature review process to support the claim of a rigorous literature review, substantiate the research problem and explain how this research makes an original and significant contribution to the body of knowledge (Levy & Ellis, 2006), expose the most influential researchers in the field, uncover the key theories, variables, relationships, and phenomena, and develop a sensitising theoretical framework.

In addition, there are specific objectives for each literature matrix concept subsection. The first literature matrix concept is environmental sustainability with the objective of answering the first research question, namely: what is environmental sustainability and why is it important? The second literature matrix concept is enabling and transforming IS with the objective of evaluating the enabling and transforming capabilities of IS in terms of fundamental business changes, which are a necessity for environmental sustainability.

The third literature matrix concept is organisational environmental strategy and management, with the objectives of elucidating the contemporary organisational environmental strategic and management contexts as they relate to environmental sustainability, assessing the prevalent degree of environmental sustainability in organisations, and hence ascertaining the necessity for leveraging the enabling and transforming capabilities of IS for environmental sustainability.

The fourth literature matrix concept is Green IS with the objective of examining contemporary Green IS research, to expose its relevance for environmental sustainability. The fifth literature matrix concept is Green IS and related frameworks, with the objective of evaluating the existing Green IS and related frameworks to determine if any of these frameworks directly explicate the enabling and transforming capabilities of Green IS and hence justify developing the framework in this research.

A detailed and justified account of the implemented systematic literature review process follows this introduction. Thereafter, Chapter Two presents the literature matrix concept subsections, namely: environmental sustainability, enabling and transforming IS, organisational environmental strategy and management, Green IS, and Green IS and related frameworks. Subsequently, the sensitising theoretical framework is depicted. Conclusions are then drawn from the aforementioned subsections.

2.2 Systematic literature review process

It is important that the literature review be systematic to enable the advancement of knowledge, facilitate theory development, and make sense out of the accumulated knowledge (Webster & Watson, 2002; Levy & Ellis, 2006). A systematic literature review uncovers the key theories, variables, relationships, and phenomena that relate to the research problem, and exposes the influential researchers in the field (Randolph, 2009). It determines to what extent other researchers have addressed the research problem (Klopper & Lubbe, 2011), prevents duplication of previous research, prevents the errors of previous research, enables original research (Hart, 2001; Kitchenham, 2004), and results in a rigorous, and auditable literature review (Kitchenham, 2004). Furthermore, a systematic literature review uncovers and justifies the applicable research methodologies for the research (Levy & Ellis, 2006; Hart, 2001).

A systematic literature review was used in this research, based on a systematic data processing approach comprising three high-level phases (Levy & Ellis, 2006). Phase 1 is the inputs phase, which is described in the systematic literature search strategy subsection. Phase 2 is the processing phase, which is demonstrated in the concept-centric literature matrix subsection. Phase 3 is the outputs phase, being the actual written literature review, presented in the literature review subsections. All phases, and especially phase 2, involve evaluation in addition to the cognitive activities of knowledge, comprehension, application, analysis, and synthesis (Levy & Ellis, 2006). The systematic literature review continued throughout the duration of the research, although at a lower intensity after Chapter Two. This ensured that the researcher was always aware of any new research that may have affected the research (Oates, 2006; Levy & Ellis, 2006; Olivier, 2004).

2.3 Inputs phase: systematic literature search strategy

2.3.1 Rationale

A systematic literature search strategy is a prerequisite for a systematic and high-quality literature review (Egger, Juni, Bartlett, Holenstein, & Sterne, 2003). The objective of such a strategy is to uncover a thorough and comprehensive set of relevant and appropriate literature

(Webster & Watson, 2002; Kitchenham & Charters, 2007). It aims to be open to scrutiny, replicable, rigorous, and unbiased (Staples & Niazi, 2007; Brocke *et al.*, 2009).

2.3.2 Keywords

A systematic literature search strategy starts with the development of keywords. Keywords are the words and terms that form the foundation for subsequent electronic literature searches. The key concepts from the research problem statement form the initial set of keywords. The research problem statement acts as a filter for literature that is relevant to the problem being addressed (Klopper & Lubbe, 2011).

The initial set of keywords is extended to include synonyms, abbreviations, alternative spellings, singular/plural, related terms, and related parts of terms (Kitchenham, 2004; Rowley & Slack, 2004). In addition, further keywords are developed from discovered relevant literature, especially from the keywords, abstract, introduction, and conclusion sections (Petersen, Feldt, Mujtaba, & Mattsson, 2008). New searches are done for each newly developed keyword or keyword combination.

2.3.3 Databases and search engines

Search engines use the developed keywords to retrieve electronic literature from databases. Some search engines can search multiple databases while others are designed for specific databases only. The selection of search engines and databases is important because it determines what literature becomes available for the subsequent phases of the systematic literature review. This research used quality search engines and databases from the library of the University of South Africa (UNISA), the library of the North-West University (NWU) in South Africa, relevant associations where the researcher has membership, and from the Internet, such as Google Scholar.

2.3.4 Literature assessment

Each search can potentially return many literature items. In order to retain only relevant (Oxman & Guyatt, 1988; Kitchenham, 2004) and quality (Levy & Ellis, 2006) literature for use in the subsequent phases of the systematic literature review, the researcher assesses each discovered literature item. The assessment involves scrutinising each literature item's title, keywords, abstract or summary, introduction, and conclusion sections for relevance to the problem statement (Klopper & Lubbe, 2011; Brocke *et al.*, 2009; Brereton, Kitchenham, Budgen, Turner, & Khalil, 2007), and where appropriate, scrutinising an entire literature item. The relevance assessment is a subjective judgement by the researcher (Mizzaro, 1997; Floridi, 2008). A literature item is relevant if it bears significantly on the research problem (Harter, 1992). More

specifically, a remotely relevant literature item can be used to support concepts only, while a literature item that is highly relevant is by nature one that has fundamentally furthered the body of knowledge applicable to the research problem and is retained for use in the subsequent phases of the systematic literature review (Levy & Ellis, 2006).

Equally important is assessing the quality of each literature item. The quality assessment involves scrutinising the publisher to ensure that each literature item has undergone a rigorous peer-review process; literature items that are not peer reviewed or that are practitioner oriented have very limited use in the subsequent phases of the systematic literature review (Levy & Ellis, 2006). Journals that are highly ranked by the academic community undergo a rigorous peer-review process and have the required quality for inclusion in the subsequent phases of the systematic literature review (Levy & Ellis, 2006). Other quality assessment criteria include the author's reputation in the field, the journal editorial board members or conference programme committee, and the length of time in existence of the journal or conference, or edition of the book (Oates, 2006). If a literature item is assessed to be relevant and of quality, then it is retained for the subsequent phases of the systematic literature review, and stored on a backed-up hard drive with the title or a shorter equivalent as the file name. Each retained literature item's corresponding reference is imported into the online bibliographic management program called Refworks (RefWorks, n.d.).

2.3.5 Search strategy implementation

The search strategy is implemented in three sequential stages. After the first iteration is completed, any of the stages can be re-executed in any order. This phase of the systematic literature review ends once a conceptual saturation point is reached, which is once no new concepts are being uncovered in the discovered literature (Webster & Watson, 2002; Levy & Ellis, 2006).

The first stage is iterative in nature. This stage involves using the developed keywords and chosen search parameters in the selected search engines and databases, and then assessing any discovered literature. Each successive search is informed by the previous searches and is refined accordingly. Search refinement is a crucial part of the search process. The refinement entails using keywords and parameters to reduce or increase the search scope and it involves keyword combination choices.

The second stage uses backward and forward searches on literature retained through the first stage (Webster & Watson, 2002; Levy & Ellis, 2006). A backward search involves finding relevant and quality literature from the references, authors, and keywords in retained literature. A forward search involves finding new relevant and quality literature items that have cited a

retained literature item, or subsequent publications of authors of retained literature items. This stage is very effective in uncovering additional relevant and quality literature. Any literature that is returned from these processes undergoes the aforementioned literature assessment before it can be retained for the subsequent phases of the systematic literature review.

The third stage is executed to address publication bias and to search for relevant and quality literature that is not available in the selected search engines and databases. This stage will include manual searches where appropriate, electronic searches of grey literature and electronic searches of conference proceedings, and it will include contacting experts, librarians, and researchers working in the area (Kitchenham, 2004; Egger *et al.*, 2003; Dyba, Dingsoyr, & Hanssen, 2007; Webster & Watson, 2002). In this regard, the researcher is also involved in a special interest group, called the Association for Information Systems Green IS special interest group (SIGGreen), providing access to experts in the field. All literature that is discovered during this search strategy undergoes the aforementioned literature assessment before it can be retained for the subsequent phases of the systematic literature review.

2.4 Processing phase: concept-centric literature matrix

The processing phase requires that evaluation be applied to the opinions, theories, and empirically established facts within the retained literature. During this phase, the cognitive activity of evaluation is supported by the cognitive activities of knowledge, comprehension, application, analysis, and synthesis (Levy & Ellis, 2006). Nevertheless, all these activities are employed throughout the three phases of the systematic literature review.

In phase 2, these cognitive activities result in a concept-centric literature matrix. The matrix is developed by mapping, in table format, the major concepts relating to the problem statement against each retained literature item (Klopper & Lubbe, 2011; Levy & Ellis, 2006). Annexure A: Concept-Centric Literature Matrix contains the resultant concept-centric literature matrix. Importantly, the matrix enables the literature to be organised around the salient concepts (Rowley & Slack, 2004; Holbrook, 2007). Furthermore, the matrix enables a high-quality literature review (Webster & Watson, 2002).

2.5 Outputs phase: literature review

The outputs phase is the actual written literature review, presenting the concepts and literature from phase 2 (Klopper & Lubbe, 2011). Phase 3 involves critical comparative analyses of all the literature under each concept, uncovering converging and diverging expert opinion (Klopper & Lubbe, 2011; Holbrook, 2007). In this phase, critical comparative analyses, argumentation analysis, and evaluation aid the achievement of the systematic literature review objectives (Levy & Ellis, 2006; Hart, 1998).

The following sections are the literature matrix concepts emerging from the literature that relate to the problem statement. The concepts are environmental sustainability; enabling and transforming IS; organisational environmental strategy and management; Green IS, and Green IS and related frameworks.

2.5.1 Environmental sustainability

2.5.1.1 Introduction

Subsection 2.5.1 focuses on the concept of environmental sustainability. Environmental sustainability eliminates the negative impacts on people resulting from environmental resource depletion and degradation. The concept of environmental sustainability is an important directing concept for this research, and consequently the objective of subsection 2.5.1 is to answer the first research question: what is environmental sustainability and why is it important?

2.5.1.2 Sustainability

The departure point for subsection 2.5.1 is the general concept of sustainability. It is evident that sustainability has two main principles, being intergenerational equity and intragenerational equity (Elliot, 2011; Sowman & Brown, 2006; Goodland, 1995), with the former being dependent on the latter (Goodland & Daly, 1996). The principle of intergenerational equity requires that resources be fairly distributed amongst future generations, while the principle of intragenerational equity requires that resources be fairly distributed amongst all people in the present generation. The dependency of intergenerational equity on intragenerational equity is supported by the argument that unless resources can be fairly distributed amongst all people in the present generation, it is improbable that this can be done amongst future generations.

Following these principles are two definitions of sustainability, a utility-based definition and a throughput-based definition (Daly, 2006). The utility-based definition is derived from the economic concept of utility, which refers to the satisfaction of consumer wants and needs by the consumption of services and goods. Utility-based sustainability is defined as the non-declining utility or non-declining average per capita utility of future generations (Daly, 2006). Utility-based sustainability has limited applicability to sustainability because utility is not directly measurable and cannot be left for future generations (Daly, 2006).

The second definition is throughput-based sustainability and it is derived from the concept of throughput, being the flow of non-renewable and renewable resources from the environmental sources, into the economy for processing, and finally back into the environmental sinks as wastes and pollution (Daly, 2006). Moreover, the magnitude of the economy is a function of throughput (Goodland, 1995). Throughput-based sustainability is then defined as the non-declining throughput that is within the regenerative capacities of the environmental sources and the

assimilative capacities of the environmental sinks (Daly, 2006; Zhao, Wu, Hong, & Zhang, 2009). In contrast with utility-based sustainability, the definition of throughput-based sustainability is valuable in the sustainability context because throughput is directly measurable and can be left for future generations (Daly, 2006). Therefore, it is the definition adopted in this research. Practically, the economy and each living entity require throughput for survival (Daly, 2006).

2.5.1.3 Carrying capacity, environmental impact, and throughput growth

It is important to introduce another concept at this point, that of carrying capacity. Carrying capacity is the population size of a species that a specific land area can sustain equally now and in the future (Goodland & Daly, 1996). Related to carrying capacity is environmental impact, which affects the carrying capacity of land areas. The environmental impact of the human population (Orimoogunje, Adegboyega, Banjo, & Funmilayo, 2011) is defined by the relationship I = P x A x T, being the product of population size (P), the population's affluence or per capita consumption (A), and the damage to the environment as a result of the technologies utilised to support each unit of consumption (T) (Daily & Ehrlich, 1992; Ehrlich & Holdren, 1971). Environmental impact has a negative relationship with carrying capacity, that is, as the environmental impact increases so the carrying capacity decreases. Consequently, environmental impact constrains throughput-based sustainability by decreasing the Earth's carrying capacity or impairing the regenerative capacities of the sources and the assimilative capacities of the sinks.

Tightly coupled with the environmental impact relationship factors is throughput growth or greater throughput (Daly, 2006) or a quantitative increase (Goodland, 1995). This is illustrated through the relationship Tp = P x Y/P x Tp/Y, with reference to the I = P x A x T relationship (Goodland *et al.*, 1994). Tp is throughput and is the product of population (P), per capita income (Y/P) and throughput intensity per unit of income (Tp/Y) (Goodland *et al.*, 1994). Comparing the two relationships, impact (I) results from throughput (Tp), population (P) is the same in both equations, affluence (A) equals per capita income (Y/P), and technology (T) is measured by throughput intensity of income or the throughput per currency unit of final goods and services (Tp/Y) (Goodland *et al.*, 1994). Importantly, infinite throughput growth is not possible within the Earth's finite system. Thus, the physical environment limits infinite throughput growth, and exposes the conflict between infinite throughput growth and throughput-based sustainability. Indeed, infinite throughput growth that surpasses the environmental regenerative and assimilative capacities is termed unsustainability (Goodland, 1995).

2.5.1.4 Development

Contrasted with throughput growth is the associated concept of development. Development refers to greater utility per unit of throughput (Daly, 2006) or a qualitative increase (Goodland, 1995), while throughput growth is a quantitative increase. The main objective of development is the reduction of poverty, hunger, illiteracy, and disease (Goodland & Daly, 1996). Nevertheless, the concept of throughput is not utilised in economics so the definition of greater utility per unit of throughput or a qualitative increase merely becomes growth in gross domestic product (GDP) or economic growth, which is the market value of all services and goods produced (Daly, 2006). This reduced definition of development resembles the definition of throughput growth, which raises conflict between development and throughput-based sustainability, due to the finite physical environment limiting infinite GDP growth or infinite economic growth.

An associated problem with this reduced definition of development is the unmeasured, externalised ecological costs or unpriced ecological inputs in production and GDP, which include pollution and loss of ecosystem goods and services (Goodland, 1995; Kemp & Soete, 1992). Externalising production costs allows manufacturers to maximise utility and competitiveness, consumers to minimise purchase costs, and both to create short- to medium-term wealth, while forcing the planet or the commons or the collective to bear the real and high costs of manufacturing, distribution, and disposal (DesAutels & Berthon, 2011). Essentially, externalised costs are market failures (Dean & McMullen, 2007). It is a tragedy of the commons situation where individual wealth is traded for collective poverty. Ultimately, collective poverty encompasses all individuals (DesAutels & Berthon, 2011). Furthermore, GDP and similar measures of development effectively treat natural capital consumption as income rather than natural capital liquidation (Goodland *et al.*, 1994). A more fitting definition for development, to negate infinite throughput growth, is improved human welfare (Goodland *et al.*, 1994).

2.5.1.5 Sustainable development

Following from the discussion on development, when the adjective 'sustainable' is used, it creates the perception of infinity. Such a perception can be misleading, as evident in the terms 'sustainable throughput growth' and 'sustainable development' (Bartlett, 1994). As already substantiated, neither of these concepts can increase indefinitely within Earth's finite system. The concept of sustainable development, as it is and has been applied, has a number of problematic characteristics. Firstly, it presents no clarity about how it excludes infinite throughput growth in order to be sustainable and it is ambiguous as to how it achieves greater utility per unit of throughput (Dernbach, 2003; Brundtland Commission, 1987). Nonetheless, its

ambiguity has facilitated its many interpretations and its widespread acceptance (Dietz & Neumayer, 2007; Laine, 2010).

In addition, measuring sustainable development is complex due to the nature of measuring social, environmental, and economic phenomena (Krajnc & Glavic, 2005), and there have been many initiatives to clarify and measure sustainable development (Parris & Kates, 2003). Additionally, there are numerous sustainable development indexes (Krajnc & Glavic, 2005; Böhringer & Jochem, 2007).

Sustainable development is widely applied in the business domain, and most often interpreted as maximising profitability while minimising environmental resource depletion and degradation. This interpretation involves compromises between economic gain, social welfare, and environmental impacts; however, always with the precondition of economic gain (Laine, 2010; Diedrich, Upham, Levidow, & van den Hove, 2011; Hanson, 2000). Furthermore, sustainable development is interpreted as a triple bottom line measurement, comprised of economic, social, and environmental measurement, with economic measurement directing decision-making (Glavic & Lukman, 2007; Banerjee, 2003). These interpretations have promoted business-as-usual or small, incremental changes, and continued environmental resource depletion and degradation (Milne, Kearins, & Walton, 2006; Parris & Kates, 2003; Cairns Jr., 1997). In essence, the future is being traded for the present (Ekins *et al.*, 2003).

Nonetheless, sustainable development can still lead to throughput-based sustainability, but only if there is output value after taking into account all the environmental costs connected with the output (Goodland & Daly, 1996). Thus, sustainable development is theoretically feasible only if it excludes infinite throughput growth or if it includes throughput growth within the environment's regeneration and assimilation capacity limits (Goodland & Daly, 1996). As a point of departure for this research, it is the concept of throughput-based sustainability, not sustainable development, that is the defined solution to environmental resource depletion and degradation.

2.5.1.6 Capital maintenance and substitutability

At this stage in the discourse, it is necessary to introduce the concept of capital, which is required to develop the concept of environmental sustainability from throughput-based sustainability. Capital exists in four types, which are manufactured capital including material tools; human capital including people's capacity for work; social or organisational capital including the networks and organisations that enable human capital; and environmental or natural or ecological capital including water, atmosphere, land, fauna, flora, and habitats (Ekins *et al.*, 2003). In addition, natural capital has the capability to perform unique environmental functions,

being the source function, the sink function, the life-support function including climate stability, and the amenity services function including open natural areas (Ekins *et al.*, 2003). The four types of capital support human existence and human welfare (Ekins *et al.*, 2003).

Specifically, it is the maintenance of the types of capital and their substitutability that are important. Based on the assumed substitutability between the capital types, there are four resulting degrees of throughput-based sustainability. These are very weak, weak or intermediate, strong, and very strong or absurdly strong (Goodland & Daly, 1996). Very weak assumes that the different types of capital are perfect substitutes so that only the aggregate capital is maintained, weak also maintains the aggregate capital but with the precondition that minimum critical levels of each capital type are maintained, strong maintains levels of each capital type and regards the capital types as complements not substitutes, and absurdly strong states that no capital type can be depleted in any way (Goodland & Daly, 1996; Ekins *et al.*, 2003).

2.5.1.7 Strong environmental sustainability

By focusing on environmental or natural capital, the different degrees of throughput-based sustainability translate into different degrees of environmental sustainability. It is evident that very weak environmental sustainability cannot be feasible (Goodland & Daly, 1996), because converting all natural capital into artefacts or manufactured capital will result in people being in a worse state than before such a conversion (Goodland, 1995). Then, the difficulty with weak environmental sustainability is that it is almost impossible to define what a minimum critical level is (Goodland & Daly, 1996). Nonetheless, weak environmental sustainability has widespread support in the business domain (Goodland, 1995). It is termed ecological modernisation and involves the practice of combining the contradictory principles of economic growth and throughput-based sustainability (Milne *et al.*, 2006). Implementations of weak environmental sustainability promote sustained capitalism and business at the expense of the environment (Laine, 2010). Weak environmental sustainability is a flexible type of environmental sustainability that accommodates current economic practices (Manzini, Islas, & Macías, 2011; Jenkin *et al.*, 2011). Notably, it has similarities to the concept of sustainable development.

In comparison, absurdly strong environmental sustainability states that no natural capital can be depleted in any way. This also applies to non-renewable resources, and only net growth increments of renewable resources can be consumed (Goodland, 1995). Absurdly strong environmental sustainability is certainly not feasible (Goodland & Daly, 1996; Ekins *et al.*, 2003). Of the four degrees of environmental sustainability, it is strong environmental sustainability that demonstrates the non-substitutability of manufactured capital for all natural

capital (Ekins *et al.*, 2003; Dietz & Neumayer, 2007). Furthermore, the indisputable scientific evidence on environmental resource depletion and degradation substantiates the necessity for strong environmental sustainability (Ekins *et al.*, 2003).

The fundamental principles of strong environmental sustainability state that the depletion rate of non-renewables must be within the development rate for renewable substitutes (Goodland & Daly, 1996), the consumption rate of renewable resources must be within the environmental regeneration rates, and waste emission rates must be within the environmental assimilation rates (Manzini *et al.*, 2011). Furthermore, seven principles that relate to the unique environmental functions guide strong environmental sustainability, namely: the prevention of destabilisation to the life-support functions, for instance climate patterns and the ozone layer; the protection of the life-support functions, for instance biodiversity; the harvesting of renewable resources at rates that do not degrade the environment; the depletion of non-renewable resources at rates that are balanced with substitute development rates; the adherence to the precautionary approach for emission limits; the preservation of landscapes for amenity services; and the termination of technologies that cause severe damage to human health and lasting damage to the environment (Ekins *et al.*, 2003). Strong environmental sustainability is the only degree of environmental sustainability that eliminates the negative impacts on people of environmental resource depletion and degradation (Ekins *et al.*, 2003).

Ultimately, strong environmental sustainability will occur, either controlled through changed human behaviour or uncontrolled through catastrophic environmental reactions (Goodland *et al.*, 1994). In order to avoid catastrophic environmental reactions and the resulting negative impacts on people, strong environmental sustainability requires fundamental changes in human behaviour, ethics, attitudes, values, lifestyles (Cairns Jr., 1997; Hovorka, Labajo, & Auerbach, 2012), and economic models (Fuchs, 2008). In terms of unit of analysis, being the organisation, strong environmental sustainability requires fundamental business changes (Milne *et al.*, 2006), and necessitates business strategies that develop clean services and products, the competencies and capabilities to utilise them, and the metrics to measure them (Elliot, 2007; Verheul & Vergragt, 1995). Indeed, strong environmental sustainability and fundamental business changes require creating a direct link between strong environmental sustainability and shareholder value (Laszlo & Laugel, 2000). Importantly, the literature indicates that it is IS, given their potential to enable and transform business organisations, that hold the key to fundamental business changes, which are necessary for strong environmental sustainability (Elliot & Binney, 2008; Fairweather, 2011; Elliot, 2011).

2.5.1.8 Summary

The objective of subsection 2.5.1 has been achieved by answering the first research question, namely: what is environmental sustainability and why is it important? The concept of environmental sustainability has been fully elucidated and it has been determined that environmental sustainability is the solution to environmental resource depletion and degradation. The fundamental principles of environmental sustainability have been defined and the implications for organisations, which are fundamental business changes, have been uncovered. Furthermore, IS can enable and transform business organisations for the necessary, fundamental business changes. The next section presents the discourse on this crucial aspect, that is, the enabling and transforming capabilities of IS.

2.5.2 Enabling and transforming IS

2.5.2.1 Introduction

Subsection 2.5.1 contained the definition of environmental sustainability, its significance, and the consequential necessity for fundamental business changes. In addition, it was determined that IS can enable and transform business organisations for these fundamental business changes. Subsection 2.5.2 elaborates on the enabling and transforming capabilities of IS. The objective of subsection 2.5.2 is to evaluate the enabling and transforming capabilities of IS in terms of fundamental business changes, which are a necessity for environmental sustainability. Notably, IS include IT and ICT (Watson, Boudreau, & Chen, 2010); thus in this section, the enabling and transforming capabilities of IT and ICT are regarded as enabling and transforming capabilities of IS.

2.5.2.2 Enabling capability: operations and management

From an enabling and operational point of view, IS have enabled massive productivity gains in the recent past (Watson, Boudreau, & Chen, 2010), both in developed and developing countries (Lee, Xiang, & Kim, 2011). IS enable the delivery of business services (Bose & Luo, 2011), flexibility, quality improvement, cost reduction, and productivity enhancement (Melville, Kraemer, & Gurbaxani, 2004; Tambe & Hitt, 2012). Furthermore, IS enable operational efficiencies (Xue, Ray, & Sambamurthy, 2012), improved supply chain production and logistics (Cheng & Nault, 2012; Han, Chang, & Hahn, 2011), transaction processing, managerial decision support, performance evaluation, and documentation and communication maintenance (Gurbaxani & Whang, 1991). For management, IS enable shared understanding, planning, implementation, evaluation (Elliot, 2011), monitoring, controlling, and decision-making

(O'Donnell & David, 2000). Indeed, IS presents intellectual and computational tools that further human problem-solving and organisational capabilities (Hevner *et al.*, 2004; Chen, 2012).

2.5.2.3 Enabling capability: information management

IS enable knowledge workers to access the information and knowledge required to be productive (Aral, Brynjolfsson, & Van Alstyne, 2012). They also enable cost-effective information acquisition and processing (Gurbaxani & Whang, 1991), which involves gathering, interpreting, and synthesising information for decision-making (Tushman & Nadler, 1978). From the perspective of organisations as open social systems and information processing systems that are confronted by external and internal sources of uncertainty, the effectiveness of an organisation may be determined by how well the information processing capacities are matched with the particular information processing requirements (Tushman & Nadler, 1978), and how well information is integrated along supply chains (Wong, Lai, & Cheng, 2011). The IS information management capability aims to provide users with data and information that is accurate, timely, reliable, secure, confidential, accessible, and flexible, for adapting to changing business environments (Mithas *et al.*, 2011). The IS information management capability and the IS infrastructure capability are key enablers in developing performance, customer, and process management capabilities that lead to organisational performance (Mithas *et al.*, 2011). The extent of any effectiveness and efficiency improvements from IS in organisations depends on the information capabilities as well as organisational characteristics, work systems, people, and development methodologies (Hevner *et al.*, 2004).

2.5.2.4 Enabling capability: performance

IS enable the creation of business value and organisational performance (Wang, Liang, Zhong, Xue, & Xiao, 2012; Kim, Shin, Kim, & Lee, 2011) through increased employee productivity; facilitated interaction between and among businesses, governments, customers and investors; and emerging real-time access, reach, and locatability or location determinability (Watson & Straub, 2007). Furthermore, IS enable organisational performance through influencing, informing, and even transferring work to stakeholders (Watson & Straub, 2007). Moreover, they enable the co-creation of value among organisations (Rai, Pavlou, Im, & Du, 2012), and enable organisations to effectively utilise external and internal knowledge for organisational performance (Roberts, Galluch, Dinger, & Grover, 2012). Additionally, end-user IS proficiency is a crucial factor determining organisational performance (Kane & Borgatti, 2011). Notably, IS may require complementary organisational structures for improved organisational performance (Tambe, Hitt, & Brynjolfsson, 2012).

2.5.2.5 Enabling capability: strategy

IS enable business strategy and organisational infrastructure (Hevner *et al.*, 2004). Research evidence mandates the alignment of IS and business strategy for gains in productivity, profit, sales revenue, and reputation (Tallon & Pinsonneault, 2011). IS have value as a business resource and contribute economically by enabling uniquely low costs or unique products and services (Hedman & Kalling, 2003; Grover & Kohli, 2012). In particular, IS-enabled organisational resources can have strategic benefits (Nevo & Wade, 2011) that provide new revenue opportunities, better customer service, continual organisational strategy reassessment, new industries and businesses (Agarwal & Lucas Jr, 2005), and new business models (Sako, 2012). IS enable enhanced strategic decision-making (Lau, Liao, Wong, & Chiu, 2012), resulting in improved processes, new business opportunities, organisational effectiveness, new markets, improved knowledge (Basahel & Irani, 2010), improved organisational performance (Leidner, Lo, & Preston, 2011), and reduced organisational risks (Dewan & Ren, 2011). Indeed, an IS such as the Internet has enabled globalisation strategies characterised by global communality in demand, global reach, removal of trade barriers, and improvements in global logistics (Yip, 2000).

2.5.2.6 Enabling capability: competitive advantage

The alignment of IS and competitive strategies are vital for organisational survival in contemporary dynamic business environments (McLaren, Head, Yuan, & Chan, 2011). IS have become an integral part of business, have greatly contributed to business competition in the last two decades, and have enabled organisations to achieve the necessary agility to remain competitive (Lu & Ramamurthy, 2011; Roberts & Grover, 2012). They have resulted in efficiencies, profitability, innovation, and competitive advantage (Dao *et al.*, 2011). Competitive advantage is an organisation's capability to uphold a dominant position in its industry. IS enable a sustained competitive advantage through increased profitability and revenue growth (Mithas, Tafti, Bardhan, & Goh, 2012), increased market share, easier access to markets, differentiated products and services, cost efficiencies, and even by changing the nature of an organisation's industry (Kettinger, Grover, Guha, & Segars, 1994; Johnston & Vitale, 1988). In addition, IS-based strategic initiatives have facilitated innovation and improved economic value, which support competitive advantage (Bose & Luo, 2011). Furthermore, IS enable an organisation to have a competitive advantage through its use of information (Peppard, 2008), by ensuring a constructive internal information economy (Zmud, Boynton, & Jacobs, 1986). Additionally, IS result in competitive advantage through radically transformed logistics, customer service, marketing, and geographical scope (Hedman & Kalling, 2003), and have a pivotal role in

facilitating business relationships with external stakeholders for strategic advantage (Bensaou & Venkatraman, 1996). Particularly in cases of IS resource rarity, non-substitutability, and inimitability, IS can enable a sustained competitive advantage (Melville *et al.*, 2004; Mithas *et al.*, 2011; Basahel & Irani, 2010).

In contrast, there is evidence that IS do not always lead to a sustained competitive advantage, and may have a negative effect on the bottom line (Kettinger *et al.*, 1994; Walsham & Sahay, 2006; Moody & Walsh, 1999; Glazer, 1993). IS, through the social and technology structures, can lead to changes in organisational effectiveness, and such changes have been for the better and worse, or there have been no changes at all; essentially it is how the IS are used that determines the organisational impact (DeSanctis & Poole, 1994). In many cases IS serve only to maintain the current competitive position and are a strategic necessity (Kettinger *et al.*, 1994). Sustained competitive advantage may require an established technological base together with significant capital availability, and may be a long and slow process of organisational infrastructure development with innovative action strategies (Kettinger *et al.*, 1994).

Furthermore, for a sustained competitive advantage from IS, the information resources must be directed by and be part of the overall business strategy; integrated into the products, processes, and services; leverage unique organisational attributes; and exploit unique business opportunities (Kettinger *et al.*, 1994; Hedman & Kalling, 2003). In particular, it is the information itself rather than the technology in IS that is the source of organisational value and competitive advantage (Glazer, 1993). Evidently, information is an organisation's main strategic asset, and enables integration and alignment of IS strategy with business strategy, while IS are the enabler for growing the production and distribution of information (Glazer, 1993). The information value chain begins with the collection of data, which is transformed into information; thereafter, the information is interpreted or modelled into knowledge, and finally knowledge affects decision-making and is the foundation for competitive advantage (Glazer, 1993). The difference between success and failure is an organisation's focus on information; information is the key factor for strategic advantage and enables service delivery, decision-making, organisational performance, and competitive advantage (Moody & Walsh, 1999).

2.5.2.7 Enabling capability: innovation

Innovations are a key factor for a corporate organisation's competitive advantage and for making structural changes to entire industries (Han *et al.*, 2012; Porter, 1985). IS are viewed as an enabler of organisational innovation, changed organisational behaviour (Elliot, 2011), and organisational wealth generation (Elliot & Binney, 2008). They facilitate innovation, especially in complex and dynamic industry environments (Xue *et al.*, 2012). Furthermore, they facilitate

new organisational forms, structures, and ways of doing business (Hevner *et al.*, 2004; Carlo, Lyytinen, & Rose, 2011), and facilitate new product innovation processes (Kleis, Chwelos, Ramirez, & Cockburn, 2012). IS-enabled innovation is beneficial because it reduces the prices of production factors, and can be an unforeseen destabilising factor by shifting production functions (King *et al.*, 1994). In addition, IS support innovation in information processing, which has been a major force of social and economic change historically (Pitt *et al.*, 2011). In developing countries, IS-enabled innovation is a necessity for networked organisations with global reach (King *et al.*, 1994).

2.5.2.8 Transforming capability: IS-based transformation

Globally, developed countries lead developing countries in IS-based organisational transformation, and use IS extensively; nevertheless developing countries view IS-based organisational transformation as a strategic resource for economic growth, social services, and institutional improvement (Avgerou, 2008; Walsham & Sahay, 2006; King *et al.*, 1994). IS are viewed as one of the main elements facilitating organisational transformation, changing the nature of work and changing organisational structures (Pitt *et al.*, 2011; Elliot, 2011; Kuo, 2010; Moreton, 1995; Gurbaxani & Whang, 1991; O'Leary & Turban, 1987; Zmud *et al.*, 1986). Furthermore, they bring about organisational transformation via disruptive innovations, business digitisation, and systemic and cross-organisational effects (Besson & Rowe, 2012), resulting in fundamental changes to management structures, business processes and practices, and employee attitudes (Orlikowski, 1996; Moreton, 1995; Melville, 2010).

2.5.2.9 Transforming capability: transformation processes

IS-based organisational transformation may follow a mimetic, coercive, or normative process. Mimetic processes are driven by uncertainty and cause an organisation to imitate other organisations, coercive processes are driven by political and legitimacy motivators, and normative processes are driven by professionalisation (DiMaggio & Powell, 1983). IS-based organisational transformation may be slow and subtle and may range from tacit, private, and unstructured to articulated, public, and more structured; from face-to-face and reactive to electronic and proactive; from call-based to expertise-based; from output-focused to a focus on process; from manual and imprecise to electronic and detailed; from tacit, experiential, and local to formulated, procedural, and distributed; and from manual, functional, local, and sporadic to electronic, cross-functional, global, and continuous (Orlikowski, 1996).

Historically, IS-based transformation has been preoccupied by mass production, bureaucracy, routinisation, standardisation, control, and automation. Currently, it occurs in an environment of flexibility, customisation, agile manufacturing, virtual corporations, self-organising teams,

instability, continuous change, and emergence (Orlikowski, 1996). Current IS-based transformation corresponds to the nature of IS artefacts, which are complex, interconnected, dynamic, and emergent (Orlikowski & Iacono, 2001), such as the emergent Internet, which is regarded as the largest IS solution (Dwyer & Hasan, 2012).

2.5.2.10 Transforming capability: virtuality and the Internet

Contemporary IS-based organisational transformations have been labelled the new global information economy delivering cost savings, efficiency, improved customer service, and new organisational forms such as virtuality involving virtual teams, virtual organisations, and virtual communities (Barrett & Walsham, 1999). These virtual structures and functions are heavily dependent on IT and are mostly unconstrained by space and time (Barrett & Walsham, 1999). Furthermore, IS-based business structure innovations, such as the virtual or ambient organisation, can transform traditional industry structures, business practices, and industry boundaries (Elliot, 2006). These structures are characterised by interorganisational systems (IOSs) facilitating networked organisations, emerging technologies, virtual resources, and communication and collaboration structures (Elliot, 2006). Industry sectors that are geographically dispersed and information-intensive and that have high transaction costs are most suitable to such transformations (Elliot, 2006). These innovative organisational structures include virtual companies, outsourcing, and work distribution, and are exemplified by the Internet, which is an IS innovation, and its effect on business models, processes, capabilities, and relationships, marketplaces, types of customers, competitive advantage, and new industries and businesses (Lucas & Grover, 2008; Avital *et al.*, 2007; Kuruzovich, 2009). Indeed, the Internet facilitates information that supports, enhances, differentiates, and substitutes for physical processes, distorts corporate organisational boundaries, transforms corporate strategies, and creates information-intensive and electronic stakeholder relationships (Straub & Watson, 2001). In addition, Internet-based commerce (i-commerce), mobile commerce (m-commerce), and ubiquitous commerce (u-commerce) radically alter traditional organisational business models and strategies, and access value far exceeding traditional commerce (Pitt *et al.*, 2011; Grover & Kohli, 2012). Moreover, the Internet is providing rapid and extensive changes through its pervasive infrastructure and connectivity, in contrast to the incremental changes provided by IS in the past (Agarwal & Lucas Jr, 2005).

2.5.2.11 Transforming capability: information management

Where uncertainty and change in the external environment motivates organisational transformation, such transformation requires increased information communication and processing by decision-makers, translating into an increased demand for organisational

information processing capabilities (Moreton, 1995). IS are the tools that provide these vital capabilities, and although they may be regarded in some instances as constraining, difficult to use, time consuming, and expensive to modify, IS provide unmatched information processing, analysing, and communicating capabilities (Moreton, 1995). Specifically, they are unique in their capability to create, modify, transmit, and store information, and this uniqueness can result in an overall transformation in an organisation's social structure, which comprises role relations based on knowledge and expertise linked to information retrieval, generation, and execution (Leonardi, 2007). Information management is a vital factor for strategic organisational transformation (Mithas *et al.*, 2011; Leonardi, 2007).

2.5.2.12 Transforming capability: socio-technical systems

IS-based organisational transformations can be unpredictable and incremental, and can involve non-technical factors including social, economic, and political factors. The transformations may not necessarily be as anticipated by those implementing the IS (Yates & van Maanen, 1996). Furthermore, IS alone cannot transform organisations; IS-based organisational transformations are achieved by a mix of technical and social factors (Robey & Sahay, 1996; Robey & Boudreau, 1999), and this is demonstrated by similar organisations changing and others not after the same IS technologies are implemented (Robey & Sahay, 1996).

Moreover, empirical research indicates that IS are just one factor in a complex process of social change involving forces both for and against organisational transformation; IS can support both these forces (Robey & Boudreau, 1999). The forces against organisational transformation include political opposition, cultural drag, institutional inertia, and existing organisational memory, while IS that complement organisational learning provide good opportunities for organisational transformation (Robey & Boudreau, 1999). Consequently, any IS-based organisational transformation is gradual and continuous, and greatly influenced by the pace of organisational learning during implementation to reduce resistance and encourage acceptance of change (Robey & Sahay, 1996). IS-based organisational transformation is dependent on acceptance, understanding, and use of the IS by the users (Robey & Sahay, 1996). In addition, it requires the organisation's strategic orientation towards change to include entrepreneurial orientation, technological opportunism, and market orientation, as well as the creation of change facilitators in the form of IS capabilities and climate for IS (Kuruzovich, 2009).

In support, historical analysis refutes the claims of technological determinism, which state that IS determine the transformation of work and organisational structures in our current age (Winter & Taylor, 1996); instead there is an emergent causality that results from the combination of IS and other factors. IS present the potential only for organisational transformation (Robey & Sahay,

1996). Social, economic, political, and cultural factors must be included as determinants (Winter & Taylor, 1996), as must other factors such as managerial context, market conditions, and industry characteristics (Gurbaxani & Whang, 1991).

Furthermore, the use of IS and not the IS investment itself must be understood when assessing organisational impacts, performance outcomes, productivity, organisational change, and organisational effectiveness; the way IS are used can result in significant organisational transformation (Orlikowski, 2000). IS both affect human action and are a product of human action (Orlikowski & Robey, 1991); they both affect and are affected by the routines and structures within organisations (Manning, 1996; Robey & Boudreau, 1999). IS influence communication within an organisation, and by changing the communication patterns, they can alter work processes, social roles, status, authority, distribution of power, and decision-making (Manning, 1996).

A contemporary perspective which explains the emergent IS-based organisational transformations that occur today, especially on the Web, is one focused on the ongoing practices of organisational actors and how they negotiate with everyday contingencies, breakdowns, exceptions, and opportunities (Orlikowski, 1996). Today, IS-based organisational transformation is founded in the day-to-day improvisations enacted by knowledgeable, organisational actors, and organisations themselves are regarded as being enactments of organisational actors, with every enactment replicating previous enactments or changing them. The changed enactments will, over time, bring about IS-based organisational transformation (Orlikowski, 1996).

Indeed, IS are socio-technical systems not just tools, and include people in the capacities of users and clients, and involve their interests and social relations (Alter, 2008). This is important in understanding how an IS accommodates complex and changing information, and how it must evolve over time with the changing socio-technical aspects (Alter, 2008). Such understanding of IS is crucial for transforming an organisation and facilitating long-term change of the socio-technical IS that is core to an organisation (Alter, 2008).

2.5.2.13 Summary

The enabling capability of IS has facilitated significant progression and advancement in organisational operations, management, information management, performance, strategy, competitive advantage, and innovation. Importantly, ineffective use of an IS can result in negative organisational impacts, and an emphasis on the information within IS is mandatory for gains from the enabling capability of IS. In conclusion, evidence indicates that the enabling capability of IS has facilitated fundamental business changes.

The transforming capability of IS has produced transformed organisations, including transformed structures, boundaries, strategies, business models, practices, processes, nature of work, stakeholder relationships, and value that far exceeds traditional commerce. This capability that is evident today produces complex and emergent changes, often involving the Web and the Internet. Notably, it is not deterministic, and organisational transformation is influenced by socio-technical aspects that include how the IS are used, the information component focus, the pace of organisational learning and the social, economic, political, and cultural contexts. Importantly, the transforming capability of IS incorporates both the technical and social factors, with evidence to indicate that the transforming capability of IS has produced fundamental business changes.

Therefore, the objective of subsection 2.5.2 has been achieved by establishing that the enabling and transforming capabilities of IS can achieve fundamental business changes, which are a necessity for environmental sustainability. In the next subsection, subsection 2.5.3, the contemporary organisational environmental strategic and management contexts are clarified as they relate to environmental sustainability. This is to ascertain the necessity for leveraging the enabling and transforming capabilities of Green IS for environmental sustainability.

2.5.3 Organisational environmental strategy and management

2.5.3.1 Introduction

As exposed in subsection 2.5.2, the enabling and transforming capabilities of IS can achieve fundamental business changes, which are a necessity for environmental sustainability. The objectives of subsection 2.5.3 are to elucidate the contemporary organisational environmental strategic and management contexts as they relate to environmental sustainability, to assess the prevalent degree of environmental sustainability in organisations, and hence ascertain the necessity for leveraging the enabling and transforming capabilities of IS for environmental sustainability.

2.5.3.2 Organisations, the environment, and strategy

Understanding the relationship between business, society, and nature is critical for environmental sustainability (Marcus, Kurucz, & Colbert, 2010). The relationship can be viewed as disparate, intertwined, or embedded (Marcus *et al.*, 2010). Only the embedded view regards business, society, and nature as a nested hierarchy, where business is completely nested in society and society is completely nested in nature. This view also depicts the actual systemic limits and dependencies of business, society, and nature and provides the necessary understanding for environmental sustainability (Marcus *et al.*, 2010; Jennings & Zandbergen, 1995). This view is withstanding the test of time (Mercier & McGowan, 1996), and it is necessary for organisations

to adopt the environment as the economic biosphere, systems for total environmental management, and green organisational design (Shrivastava & Hart, 1994). This requires fundamentally changed competitive strategies, structures and formal systems, processes and culture (Shrivastava & Hart, 1994), products (Bleischwitz, 2003), and business models (Senge, Carstedt, & Porter, 2001; Nowak, Leymann, Schumm, & Wetzstein, 2011; Machiba, 2010).

Still, corporate greening is impeded by ambiguity, uncertainty (Branzei *et al.*, 2004; Kanarattanavong & Ruenrom, 2009), and complexity (Lin & Ho, 2011), and has few proven guidelines and solutions, and few immediate pay-offs (Branzei *et al.*, 2004). Greening requires innovations brought about by technological and human creativity (Senge *et al.*, 2001; Machiba, 2010; Dangelico & Pujari, 2010) and information management and decision-making capabilities to negotiate the existing and future environmental complexities (Lewis & Stewart, 2003; Herremans, Herschovis, & Bertels, 2009; Hu & Bidanda, 2009). Greening requires challenges, changes, and adjustments to organisational routines, which include the rules, processes, strategies, technologies, cultures, and beliefs that constitute an organisation and its operations (Berkhout, Hertin, & Gann, 2006; Etzion, 2007). Importantly, greening must still adhere to the current economic rules for survival, which can be a force against greening (Senge *et al.*, 2001; Tzschentke, Kirk, & Lynch, 2008; Hendry & Vesilind, 2005).

While many businesses are not incorporating the natural environment into their business strategies (Lewis & Stewart, 2003), those that are, focus on stakeholder engagement, creative thinking, holistic approaches, systematic data collection and progress monitoring, results demonstration (Dwyer, 2009; Vormedal, 2008), long-term payoffs that measure performance relative to peers instead of absolute short-term payoffs (Gonzalez-Benito & Gonzalez-Benito, 2005), leaders' green personal values and principles, sustained performance feedback from leaders and organisational members, creative bottom-up initiatives, and top executive championing (Branzei *et al.*, 2004). Notably, an environmental strategy has the potential to result in a sustained competitive advantage (Gago & Antolin, 2004; Clarke & O'Neill, 2005; Mbohwa & Agwa-Ejon, 2011; de Villiers, Naiker, & van Staden, 2011; Polonsky, Rosenberger III, & Ottman, 1998) through cost reduction, increased market share, and technological leadership, and can result in fundamental organisational changes (Roy, Boiral, & Lagace, 2001). Other benefits of an environmental strategy include increased process efficiencies, productivity improvements, reduced compliance costs, and new market opportunities (López-Gamero, Claver-Cortés, & Molina-Azorín, 2008).

Empirical evidence shows that organisations with proactive climate change strategies and those leveraging the natural-resource-based view (NRBV) strategic capabilities outperform competitors (Michalisin & Stinchfield, 2010). The NRBV of business organisations extends the

resource-based view (RBV) of business organisations to acknowledge the constraints of the natural environment and presents three interconnected strategic capabilities for sustained competitive advantage, being pollution prevention, product stewardship, and sustainable development (Hart, 1995; Michalisin & Stinchfield, 2010). The NRBV of a business organisation has since been modified to have four strategic capabilities, being pollution prevention, product stewardship, clean technology, and base of the pyramid; each strategic capability contributes differently to competitive advantage (Hart & Dowell, 2011).

2.5.3.3 Organisational culture and learning

Greening an organisation has potential competitive advantages but requires very difficult organisational culture changes (Polonsky *et al.*, 1998). Environmental resource depletion and degradation stems from organisational culture but so do the potential solutions (Hoffman, 2010; Harris & Crane, 2002). Organisational culture describes beliefs, values, attitudes, and decision-making, directs the technological and economic organisational actions and behaviours, and any environmental solutions depend on transforming the organisational culture (Hoffman, 2010). Innovation and creativity are necessary to transform organisational culture, and barriers include individual and organisational biases and habitual routines (Hoffman, 2010). Importantly, changing the organisational system and its decision-making structures requires new information to be developed, interpreted, disseminated, and acted on (Hoffman, 2010). Furthermore, greening requires a learning organisation culture that is outward focused for proactive interaction with external environmental stakeholders and that is risk taking (Polonsky *et al.*, 1998; Pane Haden, Oyler, & Humphreys, 2009). Nonetheless, weak and ambiguous signals about environmental resource depletion and degradation and the uncertain benefits resulting from initiatives inhibit organisational learning (Berkhout *et al.*, 2006).

2.5.3.4 Strategic environmental approaches

There are many and varied strategic environmental approaches in the literature. In those organisations that have responded to environmental resource depletion and degradation, there are a number of relatively similar and often overlapping strategic approaches. An established approach is termed corporate social responsibility (CSR), which recognises that there are legitimate organisational stakeholders other than shareholders, such as employees, customers, local communities, and society (Carroll, 1991). A progressive perspective of the business in modern society and avoidance of negative publicity motivates CSR (Doh & Guay, 2006). While there is evidence that CSR and economic performance can be complementary, the strategic returns from CSR in the form of intent to purchase products, seek employment, and invest in the

organisation are dependent on awareness by individuals of the CSR initiatives, which can be low (Sen, Bhattacharya, & Korschun, 2006).

CSR can be viewed as comprising four types of social responsibilities, being the economic responsibility to maximise profits and shareholder wealth; the legal responsibility to comply with all laws and regulations; the ethical responsibility to comply with societal values, principles, standards, and norms; and the philanthropic responsibility to meet discretionary or voluntary societal expectations for being a good corporate citizen (Carroll, 1991). Indeed, CSR is not consistently defined and refers to voluntary efforts including social and environmental concerns about business strategy and operations (Reverte, 2009), with the requirement that any voluntary actions exceed those required by law (Hemingway & Maclagan, 2004). Additionally, standards such as the International Organization for Standardization (ISO) standard 14001, World Resources Institute (WRI), and the Global Reporting Initiative (GRI) have defined CSR disclosure (Reverte, 2009).

Historically, CSR was the broad corporate concept addressing environmental concerns until the 1990s (Özen & Küskü, 2009). Thereafter, the increasing importance of environmental concerns has resulted in specific emphasis on the environment through concepts such as ecological sustainability, eco-centred organisations, eco-centred management, environmental performance, corporate environmentalism, environmental commitment, and green organisational routines (Özen & Küskü, 2009). In addition, the concepts of corporate citizenship and corporate environmental citizenship (CEC) have emerged from CSR, with corporate citizenship requiring responsibility to all stakeholders, being employees, shareholders, customers, suppliers, and communities, and CEC aiming to reduce environmental harm by including voluntary and mandatory actions (Özen & Küskü, 2009). CSR also relates to corporate social performance and corporate social responsiveness (Doh & Guay, 2006).

Another approach addressing environmental resource depletion and degradation is corporate sustainable development (CSD). CSD stems from sustainable development and translates into fulfilling the requirements of organisational stakeholders, without jeopardising community resources and interests (Chow & Chen, 2012; Ellison, Laszlo, Sherman, & Whalen, 2005). CSD is similar to CSR in its ambiguity. Thus, there are difficulties defining, operationalising, and measuring CSD along its three separate but interrelated dimensions or triple bottom line; that is, social development or people, economic development or profit, and environmental development or planet (Bansal, 2005; Carter, Maloni, & Pullman, 2009). Apart from the triple bottom line, there are other frameworks aiming to operationalise environmental aspects, such as the natural step, the ecological footprint, and sustainable emissions and resource usage (Berthon, DesAutels, Donnellan, & Clark Williams, 2011).

There is also a contrarian view that corporate organisations are solely responsible to their shareholders and not to other stakeholders; only when pressures from stakeholders such as consumers make green management practices profitable should these practices be undertaken (Siegel, 2009). This is a view called environmental social responsibility (ESR) and it argues that greening must be an investment decision only, with calculated returns to further the corporate organisational strategies, and not due to societal or moral pressures (Siegel, 2009). However, government regulations are forcing ESR in some instances to address acknowledged market failures or externalities, and involve internalising the external or social costs of carbon emissions and environmental resource depletion and degradation through emissions trading or cap and trade schemes (Siegel, 2009).

A comparable approach to CSD is corporate sustainability (CS), which is adapted from sustainable development, and many business organisations are including it in their strategies (Dyllick & Hockerts, 2002). CS is composed of three types of capital, namely economic, natural, and social capital (Dyllick & Hockerts, 2002). The capital types are characterised by non-substitutability, non-linearity, and irreversibility, which substantiates their separate existence and requirements (Dyllick & Hockerts, 2002). Consequently, business organisations must integrate the economic, natural, and social dimensions into the triple bottom line, integrate the short- and long-term dimensions and consume income produced from each form of capital instead of the capital itself (Dyllick & Hockerts, 2002). In comparison, CS and CSR overlap in their focus on economic, environmental, and social aspects. However, CS differs from CSR's view that these aspects are independent and for the benefit of society; instead CS views these aspects as interrelated parts of a system and emphasises environmental conservation (Harmon & Demirkan, 2011a).

Competitiveness has motivated another concept called corporate ecological responsiveness, which addresses environmental resource depletion and degradation, and involves changes to a business organisation's products, processes, and policies to reduce harm to the natural environment (Bansal & Roth, 2000). In addition, the term 'ecologically sustainable development' (ESD) is a concept that involves economic development within the constraints of the natural environment (Shrivastava, 1995). Corporate organisations have implemented ESD through total quality environmental management, ecologically sustainable competitive strategies, technology transfers, and decreasing the impact of populations (Shrivastava, 1995; Bergmiller & McCright, 2009). The benefits of ESD include reduced operating costs, competitive advantage, improved public relations, decreased long-term risks, reduced health expenses, and staying ahead of regulation (Shrivastava, 1995).

Notably, the literature indicates that approaches such as CS, corporate ecological responsiveness, and ESD are conceptually close to the concept of strong environmental sustainability; however, they are not widespread and their practical implementations are not consistently defined. Instead, the literature indicates that the prevalent strategic responses involving the environment are more aligned with the concept of weak environmental sustainability.

2.5.3.5 Environmental management systems (EMSs)

In certain organisations where environmental management is part of corporate responsibility (Walker, Pitt, & Thakur, 2007), environmental commitment is shown by the development of an environmental policy, which is the foundation of an EMS (Roy *et al.*, 2001). Importantly, an EMS involves all the management activities concerned with an organisation's environmental policy (Wilmshurst & Frost, 2001).

A well-implemented EMS tells organisational stakeholders that environmental concerns are addressed, regulations are met, there is a culture of prevention, environmental performance is being continually improved, and social, ethical, and environmental risks are managed (Walker *et al.*, 2007). Furthermore, an EMS is key to environmental management and offers increased organisational sustainability, differentiation in the market, best practice, competitive advantage, profitability (Walker *et al.*, 2007), improved organisational image (Halkos & Evangelinos, 2002), compliance, employee engagement, stakeholder reporting (Salmi, 2008), strategic value enhancement (Darnall & Edwards Jr, 2006), business growth (Tinsley, 2002), and green strategic decision-making (Lewis & Stewart, 2003). Nevertheless, EMSs are complex and impact organisational and individual values, as well as organisational structures and systems (Tinsley, 2002). An effective EMS must adapt to its particular business context and the organisation's business strategy (Tinsley, 2002). However, even simple EMSs facilitate good environmental practices (Cordano, Marshall, & Silverman, 2010).

In particular, an EMS addresses uncertainty and legitimacy and may be driven by mimetic, coercive, or normative pressures (Salmi, 2008). Institutional theory explains how the mimetic, coercive, and normative pressures may influence a business organisation's adoption of environmental management practices, such as an EMS (Delmas & Toffel, 2004). Individual business organisation and factory or plant level moderating factors affect the perceptions and actions in response to these pressures. The result is heterogeneous environmental management practices (Delmas & Toffel, 2004).

ISO 14001 is the international standard specification for an EMS (Padma, Ganesh, & Rajendran, 2008). It focuses on processes rather than specific products and services and can be viewed as a framework (Padma *et al.*, 2008; Renwick, Redman, & Maguire, 2012). Indeed, global trade for

many international corporations necessitates management system certification for the ISO 14001 environmental systems standard; however, certification demands data and documentation to substantiate the quality of the EMS (Bamber, Sharp, & Hides, 2002). Other certified EMS standards are the British Standard 7750 (BS7750) and the European Community's Eco-Management and Audit Scheme (EMAS) (Tinsley, 2002; Pérez, Ruiz, & Fenech, 2007).

Importantly, an EMS is only a management tool and might not result in improved environmental management or sustainable development (von Malmborg, 2002). It presents a structure only, and requires innovation to create communicative action and organisational learning. Communicative action refers to the participative process of information creation and sharing for consensus, and organisational learning refers to organisational change through knowledge acquisition and subsequent action (von Malmborg, 2002).

2.5.3.6 Green supply chain management (GSCM)

Integral to strategic environmental management is green supply chain management (GSCM) (Cai *et al.*, 2008; Lewis & Stewart, 2003; Green, Morton, & New, 2000). The drivers that lead to the institutional mimetic, coercive, and normative pressures for GSCM adoption are the perceived success of GSCM pioneers, regulatory forces, strategic alignment with customers and suppliers that have GSCM strategies, GSCM strategy in the industry, and public concerns (Cai *et al.*, 2008). GSCM aims to balance cost reduction, innovation, regulatory pressures, market pressures, and environmental or ecological performance (Zhu, Sarkis, & Lai, 2008; Ryoo, Koo, & Wati, 2011). GSCM practices mitigate risk, reduce costs, respond to customers and regulations (Hu & Hsu, 2010), and result in improved competitiveness and economic performance (Rao & Holt, 2005; Cordeiro, Lai, Sarkis, & Zhu, 2008).

GSCM includes internal environmental management, green purchasing, customer cooperation, investment recovery, closed loop supply chains (CLSC), and eco-design (Zhu *et al.*, 2008). Internal environmental management refers to senior management support. Green purchasing refers to the inbound or upstream part of the supply chain, environmental requirements for supplier products, jointly addressing suppliers' environmental objectives, environmental audits of suppliers, and ISO 14001 certification of suppliers. Customer cooperation involves customer support. Investment recovery involves the back end of the supply chain for product recovery at end of life in order to close the loop for the CLSC (Atasu, Van Wassenhove, & Sarvary, 2009) and eco-design involves designing for environmental performance, product stewardship, reverse logistics, disassembly, and recycling (Zhu *et al.*, 2008; Zhu & Sarkis, 2007; Hervani, Helms, & Sarkis, 2005; Cordeiro *et al.*, 2008). A concept related to GSCM is sustainable supply chain management, which comprises the stages of pre-manufacture, manufacture, use, and post-use,

and the six principles or 6Rs of reduce, reuse, recycle, recover, redesign, and remanufacture (Aarabi *et al.*, 2011).

Performance management of GSCM is a necessity as the natural environment becomes key to long-term sustainability (Hervani *et al.*, 2005). GSCM performance management systems (GSCM/PMS) are scant due to heterogeneous data, technical integration difficulties, cultural and geographical diversity, different organisational policies, disagreement on metrics, numerous supply chain tiers, and unclear rationales for the system (Hervani *et al.*, 2005). GSCM/PMS aim to provide external reporting, internal control, and internal analysis (Hervani *et al.*, 2005).

2.5.3.7 Environmental reporting and accounting

Environmental reporting presents numerous business benefits, such as improved internal environmental commitment, stakeholders being informed of environmental performance, better public relations, increased employee environmental awareness, and exposed areas for management system improvements (Fortes, 2002; Chang, Yen, Li, Chang, & Chen, 2011). Furthermore, motivations for environmental reporting include compliance with current and future regulations, compliance with industry codes, reduced operational costs, improved stakeholder relations, improved organisational visibility, better competitive advantage, organisation legitimation, adherence to social norms, and social responsibility (Morhardt, Baird, & Freeman, 2002).

Environmental reporting difficulties involve the recognition of environmental costs and benefits and report verification for establishing reliability (Fortes, 2002). Traditional accounting reports are not suitable for environmental reporting because they do not account for air, water, or land as costs of production, they do not account for green assets, and they are concerned with short- to medium-term projections only (Fortes, 2002). Nevertheless, environmental reporting and accounting must be included in capital budgeting and cost allocation (Fortes, 2002).

Triple bottom line reporting is a popular method of incorporating environmental reporting into corporate reporting, and it includes economic, societal, and environmental aspects (Davidson & Wilson, 2006). However, triple bottom line reporting still presents a limited view on the environmental aspects and omits many externalities (Davidson & Wilson, 2006). Other reporting initiatives that aim to address these reporting deficiencies are the GRI, which was launched in 1997 by the United States (US) non-governmental organisation Coalition for Environmentally Responsible Economies (CERES) and the United Nations Environment Programme (UNEP), which is a leading initiative for consistent, rigorous, comparable, and credible sustainable reporting (Davidson & Wilson, 2006). In addition, the ISO 14031 environmental performance evaluation standard is a comparable global reporting standard (Morhardt *et al.*, 2002).

2.5.3.8 Green marketing and demand

Competitiveness, legitimation, and ecological responsibility motivate green marketing (Simula, Lehtimäki, & Salo, 2009; Rivera-Camino, 2007). Other terms for green marketing are environmental marketing, ecological marketing, greener marketing, sustainable marketing, and marketing of green products (Simula *et al.*, 2009). Green marketing is the marketing activity of gathering market data and distributing information about products. In addition, it aims for low impacts on the environment of the marketing process itself and of the products being marketed (Simula *et al.*, 2009; D'Souza, Taghian, & Khosla, 2007). It also aims to understand customers' green values, needs, and wants, and to provide the appropriate green products and services with honesty and integrity (Simula *et al.*, 2009). Notably, there are a number of related practices that detract from the honesty and integrity of green marketing; these are green spinning, green selling, green harvesting, enviropreneurial marketing, compliance marketing, and green washing (Simula *et al.*, 2009). Green spinning refers to reactive public relations; green selling refers to exaggerated green claims; green harvesting emphasises short-term profitability; enviropreneurial marketing refers to incomplete market data; compliance marketing refers to minimal legislative compliance; and green washing refers to misleading or false environmental claims (Simula *et al.*, 2009).

Benefits from green marketing include resource cost savings and increased profits, improved reputation and brand image, competitive advantage, social responsibility, compliance with legislation, and a positive impact on the environment (Simula *et al.*, 2009; Nishant, Teo, & Goh, 2011). Nevertheless, consumers only consider green products after product need, price, personal preference, and budget (Suplico, 2009). Although there may be an intention to prefer products that are non-toxic, recyclable, reusable, refillable, degradable, non-polluting, not tested on animals, ozone friendly, energy efficient and result in little household waste, these are not first priority purchasing decisions (Suplico, 2009).

The effect is a consumer buying behaviour gap between values that involve protecting the environment and actual green purchases (Young, Hwang, McDonald, & Oates, 2010; Bergin-Seers & Mair, 2009). Some of the main factors involved in green purchasing are consumers' green values, purchase experience, time for research and decision-making, knowledge of the environmental concerns, green product availability, and financial resources (Young *et al.*, 2010). Education and research, and information interpretation and decision-making are essential to developing the necessary environmental values that initiate green purchases (Young *et al.*, 2010). Information is critical, such as eco-footprinting analysis and the European Union (EU) energy label, but requires regulation to prevent greenwashing (Young *et al.*, 2010). Removing the cost

barriers of research, information interpretation, and decision-making is important (Young *et al.*, 2010).

Essentially, green consumers require integrated and trustworthy information sources about products and the producing organisations (Oates, McDonald, Alevizou, Hwang, Young, & McMorland, 2008). In addition, public education, based on good and accessible information, is mandatory to effect the necessary changes to individual behaviours and norms to prevent environmental harm (Babcock, 2009). Public education should ideally be accompanied by penalties for damaging behaviour, economic incentives, and public information about action consequences (Babcock, 2009). Importantly, green consumerism still advocates consumerism by providing a market for green products motivated by profit, as opposed to no consumerism. This is expected to have little positive effect on the environment if the total level of consumption is maintained, as all consumption causes indirect and direct environmental resource depletion and degradation (Alfredsson, 2004; Machiba, 2010).

2.5.3.9 Developing countries

Business organisations in developing countries are perceived as having very little potential for achieving environmental sustainability. This perception is based on literature which demonstrates that developing countries are growth-based economies, they have an absence of environmental regulation enforcement, they have immature environmental movements, and they are affected by transnational economic drivers that create a comparative advantage through pollution (Pulver, 2007; Özen & Küskü, 2009). However, there is contrasting literature illustrating significant progress toward environmental sustainability by business organisations in developing countries. This progress is due mainly to different transnational drivers or globalisation involving export orientation that requires clean technologies; foreign direct investment, trade liberalisation, and clean technology transfer; international regulation; and the transfer of environmental norms (Pulver, 2007; Perkins, 2007). Moreover, this progress is due to purposeful involvement that creates access to transnational resources, institutions, and ideas; it is not due to a forceful globalised push and it is not accompanied by a forceful rejection of globalisation (Pulver, 2007).

Notably, developing countries are not yet bound to the embedded polluting infrastructures that characterise developed countries, and this presents opportunities for clean technology innovations (Pulver, 2007). Paradoxically, industrialisation by developing countries may provide the foundations for their low-carbon economies in the form of economic resources, improved infrastructure, technology transfer, and enhanced human technological capabilities (Zhang, 2011). Nevertheless, industrialisation in a decarbonising world is a difficulty. It may be easier for

developing countries with lower emissions, such as sub-Saharan Africa, than for developing countries with higher emissions, such as China and India (Zhang, 2011).

Nevertheless, South African businesses are making progress toward greening through strategic changes and adherence to regulations; however, there are still many businesses that are not focused on making such changes (Smith & Perks, 2010). Some of the South African drivers for greening are the King III reporting standards for triple bottom-line reporting, namely economic, social and environmental reporting; the ISO 14000 standards, especially ISO 14001 and ISO 14002; and the EMAS certification requirements (Smith & Perks, 2010). General management and human resource management are seen as key for driving green strategies throughout South African businesses, especially in business functions were greening is lacking, such as general management, human resources, purchasing, supply chain management, finance, and IT (Smith & Perks, 2010).

2.5.3.10 Summary

It is evident from the literature that organisations are acknowledging their absolute dependence on the environment for survival. Such acknowledgement has resulted in many and varied organisational environmental strategic and management responses. Importantly, current economics still binds organisations and promotes environmental resource depletion and degradation, especially through externalities. The result is a balancing of, with compromises between, economic, environmental, and social objectives. This produces a weak form of environmental sustainability. In addition, information, information management, and related decision support are critical for navigating the uncertainties, ambiguities, and complexities characterising environmental sustainability in organisations. It has been demonstrated in subsection 2.5.3 that organisations continue to progress at various speeds toward various forms of environmental sustainability. Indeed, no fundamental business changes, which are a necessity for environmental sustainability, are prevalent. Thus, the enabling and transforming capabilities of IS present important opportunities to advance environmental sustainability.

In summary, the objectives of subsection 2.5.3 have been achieved by elucidating the contemporary organisational environmental strategic and management contexts as they relate to environmental sustainability, assessing the prevalent degree of environmental sustainability in organisations, and hence ascertaining the necessity for leveraging the enabling and transforming capabilities of IS for environmental sustainability. Specifically, where IS support the goal of environmental sustainability, these IS are termed Green IS (Watson, Boudreau, & Chen, 2010; Lee, 2004; Watson *et al.*, 2008). Contemporary Green IS research is examined in subsection 2.5.4 to determine its relevance for environmental sustainability.

2.5.4 Green IS

2.5.4.1 Introduction

The contemporary organisational environmental strategic and management contexts were elucidated in relation to environmental sustainability, in subsection 2.5.3. As mentioned, there is a need for leveraging the enabling and transforming capabilities of IS for environmental sustainability. Contemporary Green IS research is examined in subsection 2.5.4 to determine its relevance for environmental sustainability.

2.5.4.2 Green IS promoting environmental sustainability

Most Green IS have focused on regulatory compliance reporting, decreasing energy consumption, and reducing carbon emissions (Loos *et al.*, 2011; Rikhardsson, 2001; Hilpert, Thoroe, & Schumann, 2011); however there is an urgent need for Green IS to transform business practices and work systems (van Osch & Avital, 2011). This requires the collaboration of many stakeholders internal and external to each organisation to facilitate changes for the creation of environmental, social, and economic value and to facilitate changes to norms and values (van Osch & Avital, 2011; Hjalmarsson & Lind, 2011; Shrivastava & Hart, 1994).

Indeed, the difficulty of solving environmental resource depletion and degradation necessitates different ways of thinking about technology (Berthon *et al.*, 2011). The thinking that technology is just a means to an end and a product and that the environment is an exploitable resource, promotes environmental resource depletion and degradation (Berthon *et al.*, 2011). Technology and the environment are emergent and evolving entities that change people in the process of their evolution; thus IS are an integral part of the transformation for environmental sustainability (Berthon *et al.*, 2011). Green IS offer solutions to the highly complex problem of environmental resource depletion and degradation, which has systemically interconnected and interdependent features, by addressing the socio-technical aspects of these complex problem scenarios and supporting bottom-up, localised, and emergent approaches (Dwyer & Hasan, 2012; van Osch & Avital, 2011; Loos *et al.*, 2011). Green IS can transform business processes for long-term environmental sustainability, by enabling the bottom-up changes to culture, social norms, attitudes, and behaviour (Dwyer & Hasan, 2012; Seidel & Recker, 2012). Green IS are enablers of environmental sustainability, promoters of environmentally sustainable behaviours and agents of transformation for environmental sustainability (Ijab, 2011; Jenkin *et al.*, 2011).

Green IS are strategic and key to implementing sustainability initiatives that change organisational routines, standards, and human behaviour (Bengtsson & Ågerfalk, 2011). They are key change actants, create organisational commitment to sustainability, enable employee education and active participation, expose sustainability to stakeholders, promote rapid change,

and facilitate continuous improvement (Bengtsson & Ågerfalk, 2011). In addition, Green IS enable an organisational redesign strategy where the internal structure, organisational chart, business processes, business opportunities, and corporate culture are transformed (Hedman & Henningsson, 2011).

Additionally, Green IS are the foundation for environmental management and support environmental management systems and stakeholder reporting (Green Jr, Zelbst, Meacham, & Bhadauria, 2012). They enable environmental sustainability to be integrated into daily operations, and positively impact new products and services, compliance, costs, reputation, and revenues (Curry, Hasan, ul Hassan, Herstand, & O'Riain, 2011). Green IS involve business and IS engineering in transforming business activities and enabling sustainable business processes (Loos *et al.*, 2011). In particular, they can be viewed as the leading set of technologies for protecting the environment (Loos et al., 2011; Ham, Midden, & Beute, 2009; Zapico, Turpeinen, & Brandt, 2009; Kim, Hong, & Magerko, 2010; Paulos & Pierce, 2011; He, Greenberg, & Huang, 2010; Pitt et al., 2011; Pierce, Odom, & Blevis, 2008; Hay & Rice, 2009; Ramchurn, Vytelingum, Rogers, & Jennings, 2011; Cserny, Kovács, Domokos, & Rédey, 2009).

2.5.4.3 Green IS promoting environmental resource depletion and degradation

IS are powerful facilitators of organisational environmental impacts, positive and negative, intentional and unintentional. They present both opportunities and risks to environmental sustainability, which necessitates extreme attention to the actual impacts of developed systems (Melville, 2012; Berthon & Donnellan, 2011; Fuchs, 2008; Hilty *et al.*, 2006).

The information economy, enabled by IS including the Internet, may reduce the economy's overall emissions by reducing energy intensity, which is a measure of the energy efficiency or the electricity consumption per unit of production (Laitner, 2002; Collard, Feve, & Portier, 2005). This is possible due to IS enabling new materials and new economic activities; computer-aided optimisation of energy use; interactive, real-time data to cross temporal and spatial boundaries, and the effect of knowledge, innovation, and speed (Laitner, 2002). However, an expanding GDP, supported by the information economy, can negate any energy intensity and emission reductions (Laitner, 2002).

While the move to an information society proposes reduced environmental impacts through dematerialisation of production or product to service shifts or virtual goods (Casal, van Wunnik, Sancho, Burgelman, & Desruelle, 2005; Hilty *et al.*, 2006; Huang, 2009), this is only a small percentage of the total economy and it is based on ever-increasing fossil fuel combustion (Fuchs, 2008). In addition, telework and teleconferences reduce travelling and related emissions, but teleworkers are only a small percentage of the work population. Work-related travel accounts for

only a small percentage of the total carbon emissions, telework and teleconferences can create new relationships and the need for travel, and the total distance travelled per employee is still increasing (Fuchs, 2008; Hilty *et al.*, 2006).

Notably, efficiencies due to IS, such as transport efficiencies, are subject to the rebound or Jevons effect and result in increased demand, consumption, and environmental damage (Fuchs, 2008; Hilty *et al.*, 2006; Casal *et al.*, 2005; Malmodin *et al.*, 2010). The Jevons effect occurs when increases in efficiency in the use of a resource lower the cost of the resource, which increases the demand for it and consequently increases its consumption, negating any efficiency savings (Daly, 2006).

In addition, IS can increase environmental resource depletion and degradation by growing demand and consumerism of both IT products and other products through extensive advertising reach and globalisation of markets, supporting wealth generation for the already wealthy (Fairweather, 2011), increasing energy use and electronic waste (Chen, Boudreau, & Watson, 2008), and creating an upgrade treadmill for IT hardware, because reusable and upgradeable products oppose economic gain (Chen *et al.*, 2008; Fuchs, 2008).

Importantly, where there are environmental benefits from Green IS in some areas, these must not be cancelled out by Green IS environmental damage in other areas, such as energy savings in production being cancelled out by increased energy consumption by Green IS (Hilty *et al.*, 2006; Catulli & Fryer, 2012). There is no single Green IS approach for environmental sustainability that fits all scenarios; it is necessary to recognise both opportunities and risks, and then maximise the opportunities and minimise the risks for an overall improvement (Fuchs, 2008; Vazquez, Rocha, Dominguez, Morales, & Ahluwalia, 2011; Loos *et al.*, 2011; Hilty *et al.*, 2006; Casal *et al.*, 2005; Zhang, Liu, & Li, 2011).

2.5.4.4 Green IS and environmental information and knowledge

From a broad perspective, Green IS convey environmental knowledge in support of transformation away from economic consumerism to the interrelated sustainability of humans, society, and nature (Fuchs, 2008). In this regard, Green IS present an opportunity to provide the environmental costs of products to consumers, which is expected to be the catalyst for changing consumption behaviour that damages the environment (Banerjee, 2003). This is evident in Green IS that show consumers the environmental impacts of entire supply chains (Hedman & Henningsson, 2011).

Green IS aim to change the economy's impact on the environment through the monitoring and control of complex environmental aspects, involving spatial, temporal, and organisational data (Allenby *et al.*, 2001). They enable environmental knowledge creation and management to

prevent environmental mistakes, and disseminate environmental experiences, information, and knowledge (Allenby *et al.*, 2001; Glavic & Lukman, 2007). Furthermore, Green IS, through environmental knowledge creation and management, influence investment decisions, suppliers and customers, and create systemic change (Allenby *et al.*, 2001). In this regard, the Internet, a global IS, is unique in its capability to disseminate information; thus it has great potential for environmental initiatives (Allenby *et al.*, 2001; Isenmann, Gomez, & Supke, 2011; Shaft, Sharfman, & Swahn, 2001; Rahimifard, Newman, & Rahimifard, 2004; Sen, Moore, & Hess, 2000; Kim, Shin, Choe, Seibert, & Walz, 2012) such as being the platform and model for a global network of linked environmental sensor networks (Watson, Corbett, Boudreau, & Webster, 2012).

Similarly, from an organisational perspective, Green IS provide vital information about environmental problems and opportunities (Shrivastava & Hart, 1994). Improved environmental performance requires the collection and distribution of environmental information, enabling learning and best practices (Shrivastava & Hart, 1994). Green IS provide the critical information that enables and motivates green business solutions and behaviours (Watson, Boudreau, & Chen, 2010; Watson, Boudreau, Chen, & Sepúlveda, 2011).

Essentially, all environmental initiatives require environmental knowledge, high-quality environmental information and technologically and environmentally literate people (Allenby *et al.*, 2001; Todorov & Marinova, 2010). In response, Green IS provide the environmental knowledge, environmental information processing and response capabilities for organisations concerning the environment, and enable environmental decision-making based on large-scale and complex environmental information (Holmström, Mathiassen, Sandberg, & Wimelius, 2010; Nguyen, Höglund-Isaksson, & Wagner, 2010; El-Gayar, Deokar, Michels, & Fosnight, 2011; Denzer, Schlobinski, & Gidhagen, 2011).

2.5.4.5 Green IS and environmental measurement

Green IS are suitable for addressing the considerable cognitive load of organisational environmental information and assist in embedding sustainability into an organisation's culture and operations (Volkoff, Bertels, & Papania, 2011). For instance, in operations, Green IS support green material requirements planning by providing quality and cost information about products, processes, and wastes. This results in improved cost allocation, proactive problem identification, waste management planning, documentation, regulatory compliance, integrated resource management, and interfunctional communication (Melnyk, Sroufe, Montabon, & Calantone, 1999; Aarabi *et al.*, 2011).

Furthermore, Green IS enable environmental sustainability through the provision of timely, accurate, and useful information regarding the flows of energy, water, materials, and related monetary values (Curry *et al.*, 2011). The use of Green IS to generate digital data motivates environmental sustainability changes, resulting in operational improvements and efficiencies, emission reductions, maintenance cost reductions, and increased profitability (Watson, Boudreau, Li, & Levis, 2010). Indeed, adding information to energy usage results in reduced energy usage (Watson, Boudreau, Li, & Levis, 2010).

In particular, Green IS facilitate the measurement of complex environmental sustainability measures to reduce uncertainty and risk in environmental sustainability decision-making (Corbett, Webster, Boudreau, & Watson, 2011). Specifically, they implement measurement principles relating to environmental sustainability so that appropriate, reliable, and actionable information reaches decision-makers (Corbett *et al.*, 2011). Such measurement principles are uniformity, transferability, integrability, accuracy, transparency, granularity, scope-range, and scope-inclusion (Corbett *et al.*, 2011).

Moreover, measuring environmental sustainability and holding organisations accountable for changes in the environment necessitate measurable, reportable, and verifiable indicators, both quantitative and qualitative (Moldan, Janousková, & Hák, 2011; Dewulf & van Langenhove, 2005). Generally, the availability of data is not problematic; rather the selection, interpretation and use of indicators is problematic (Moldan *et al.*, 2011). Green IS present opportunities for measuring and monitoring environmental sustainability indicators, and aim for indicator uniformity for meaningful comparisons and recognition of salient differences (Moldan *et al.*, 2011).

Various bodies have developed environmental indicators, such as the Association of Chartered and Certified Accountants Report on Environment-Related Performance Measurement, the GRI; the EU EMAS, the National Round Table on the Environment and the Economy, the World Business Council on Sustainable Development Report – Ecoefficiency Metrics, the WRI Report, the European Environment Agency Working Paper on Eco-efficiency Indicators, the ISO 14031 - Environmental Performance Evaluation, and the Guide to Corporate Environmental Indicators by the German Federal Environmental Agency (Mbohwa & Agwa-Ejon, 2011).

Nevertheless, there are Green IS information challenges, which include information granularity and overload, differing perspectives of the same aspects, and heterogeneous data and systems (Curry *et al.*, 2011; Chow & Chen, 2012). Additional difficulties of environmental information are incompleteness, ineffective understanding, lack of information generation, lack of information processing speed (Holmström *et al.*, 2010), quantification complexity, and the lack of international standards (Achim, Cioara, Ienciu, & Matis, 2009). Environmental data ambiguity

is particularly problematic (Volkoff *et al.*, 2011), and data complexities include spatial and temporal data size, distributed data, inconsistent spatial and temporal scales, and the inherent uncertainty and fuzziness of environmental data (El-Gayar & Fritz, 2006).

2.5.4.6 Green IS and information strategy

Essentially, environmental sustainability requires an information strategy to enable accurate pricing that includes externalised environmental costs and to inform individuals, organisations, and governments, so that they can determine the environmental consequences of their decisions (Watson *et al.*, 2012). Accurate pricing necessitates Green IS, and informing involves environmental sustainability reporting, product information, and environmental impact feedback (Watson *et al.*, 2012). An information strategy aims to change individual and organisational behaviour through the collection, presentation, and dissemination of accurate, meaningful, and actionable information concerning the environmental impact of decisions (Watson *et al.*, 2012). Digital information is especially useful when developing product databases with environmental calculations to enable public and convenient green comparisons of products by consumers to promote green purchasing decisions (Watson *et al.*, 2012).

2.5.4.7 Green IS drivers

Mimetic, normative, and coercive institutional pressures influence the development of Green IS for organisational eco-efficiency, eco-equity, and eco-effectiveness through the IS roles of automating, large-scale learning, informating up and down, and transforming (Chen *et al.*, 2008). Consequently, Green IS adoption facilitates the NRBV strategies of pollution prevention, product stewardship, and sustainable development, presenting solutions to environmental resource depletion and degradation (Chen, Watson, Boudreau, & Karahanna, 2010). In addition, drivers of Green IS include economic cost benefits, compliance with regulations, gaining normative legitimacy (Molla, Pittayachawan, Corbitt, & Deng, 2009; Watson, Boudreau, & Chen, 2010), voluntary environmental standards, CSR, consumer demand, and market competition (Catulli & Fryer, 2012).

2.5.4.8 Green IS and performance and competitive advantage

Green IS present capabilities that have been shown to enable the higher-order capability of proactive corporate environmental strategy, resulting in improved firm performance (Benitez-Amado & Walczuch, 2012; Benitez-Amado & Walczuch, 2011). Generally, IS resources facilitate the development of sustainability capabilities for improved economic, environmental, and social performance (Dao *et al.*, 2011; Ijab, Molla, & Cooper, 2011). Indeed, IS are viewed as a core resource and service for enabling CSR and CS business strategies and competitive

advantage through the creation of innovative products, services, processes, business models, new markets, improved collaboration and coordination, and the facilitation of organisational learning and culture change (Harmon & Demirkan, 2011a). Furthermore, the strategic balanced scorecard (BSC) (Wati & Koo, 2011) and the IT BSC (Erek, 2011) can assist Green IS strategy for environmental responsibility and competitive advantage (Wati & Koo, 2011).

Green IS are key to the establishment, maintenance, existence, and implementation of green supply chains and the resulting organisational performance (Green Jr, Zelbst, Meacham, & Bhadauria, 2012). This is achieved by Green IS facilitating information sharing and collaboration, supporting interconnectedness, establishing trust and commitment, integrating and coordinating environmental sustainability initiatives, supporting decision-making, and monitoring environmental performance and processes (Green Jr, Zelbst, Meacham, & Bhadauria, 2012).

2.5.4.9 Summary

There are both environmental sustainability opportunities and risks to any Green IS approach, requiring attention to ensure that the opportunities are maximised and the risks minimised. Moreover, Green IS present solutions to the highly complex problem of environmental resource depletion and degradation, specifically by addressing both the social and technical aspects of the problem. Furthermore, they facilitate the vital information and knowledge which concerns the flows of resources, wastes, and their corresponding monetary values, for environmental sustainability in organisations. Importantly, environmental information quality is a nontrivial consideration in any Green IS instance. The objective of subsection 2.5.4 has been achieved by examining contemporary Green IS research, and determining its relevance for environmental sustainability. In subsection 2.5.5, the existing Green IS and related frameworks are evaluated to determine if any of these frameworks directly explicate the enabling and transforming capabilities of Green IS and hence justify developing the framework in this research.

2.5.5 Green IS and related frameworks

2.5.5.1 Introduction

Subsection 2.5.4 dealt with contemporary Green IS research and its relevance for environmental sustainability. The objective of subsection 2.5.5 is to evaluate the existing Green IS and related frameworks to determine if any of these frameworks directly explicate the enabling and transforming capabilities of Green IS and hence justify developing the framework in this research.

2.5.5.2 Frameworks

The related frameworks in the literature are both non-empirical and empirical. The non-empirical frameworks are frameworks that have been developed without empirical data and have not been empirically verified. Still, they develop essential theory and deepen the body of knowledge. The empirical frameworks comprise frameworks developed with qualitative or quantitative empirical data. The frameworks developed with qualitative empirical data stem mainly from case study research. The advantage of frameworks based on case study research is that they provide extensive insight into the phenomena being studied; however, their generalisability and applicability are limited. The frameworks that have been developed with quantitative empirical data stem mainly from survey research, using techniques such as structural equation modelling and principal component analysis. The advantage of these frameworks is their generalisability and applicability; however, they lack the in-depth insight provided by the frameworks developed with qualitative empirical data.

Importantly, none of the frameworks specifically explicates the enabling and transforming capabilities of Green IS for environmental sustainability (Howard & Lubbe, 2012). Table 1, below lists the evaluated Green IS and related frameworks, indicates the development basis of each framework, and provides a brief description of each framework's focus.

No.	Author/s, Year	Framework Basis	Framework Focus Brief
1.	Elliot (2011)	non-empirical	Broad focus, provides an extensive resource base and is aimed at a diverse audience.
2.	Jenkin *et al.* (2011)	non-empirical	Guiding future Green IT/Green IS research.
3.	Melville (2010)	non-empirical	Provision of a research agenda on IS innovation for environmental sustainability.
4.	Hasan & Alony (2011)	non-empirical	Practical suggestions and a corresponding research agenda for achieving environmental sustainability.
5.	El-Gayar & Fritz (2006)	non-empirical	Research opportunities between organisational environmental management and IS.
6.	Ijab *et al.* (2010)	non-empirical	Conceptualising Green IS.
7.	Ijab & Molla (2011)	non-empirical	Understanding Green IS from a practice perspective.
8.	Watson *et al.* (2008)	non-empirical	Identifying Green IS opportunities and promoting sustainable development.
9.	Watson, Boudreau, & Chen (2010)	non-empirical	IS for the efficiency of energy consumption and distribution networks.
10.	Watson, Williamson, Boudreau, Li, & Zeng (2011)	non-empirical	Incorporating business planning for reduced organisational energy consumption.
11.	Dedrick (2010)	non-empirical	The IS potential to increase carbon productivity.
12.	Epstein & Roy (2001)	non-empirical	The drivers of corporate social performance.

No.	Author/s, Year	Framework Basis	Framework Focus Brief
13.	Dao *et al.* (2011)	non-empirical	The creation of organisational sustainability capabilities to gain sustained competitive advantage.
14.	Molla *et al.* (2008)	non-empirical	Evaluating organisational readiness for adopting Green IT.
15.	Donnellan, Sheridan, & Curry (2011)	non-empirical	Assessing the maturity of sustainable ICT capabilities.
16.	Bose & Luo (2011)	non-empirical	Assessment of organisational readiness to go green via IT-enabled virtualisation.
17.	Molla (2008)	non-empirical	Predicting the breadth and depth of Green IT adoption.
18.	Elliot & Binney (2008)	empirical data - qualitative	The development of corporate ICT practices that are beneficial to the environment.
19.	Elliot (2009)	empirical data - qualitative	The development of small and medium enterprise (SME) ICT practice, and research agenda.
20.	Butler (2011a)	empirical data - qualitative	Demonstrating that IT manufacturers need Green IS to address institutional environment requirements.
21.	Butler (2011b)	empirical data - qualitative	The reduction of organisational GHG emissions.
22.	Bengtsson & Ågerfalk (2011)	empirical data - qualitative	Describing the central change actant roles of IS and IT.
23.	Chen, Yu, Liaw, & Huang (2010)	empirical data - qualitative	Developing a complete information environment for environmental management.
24.	Nedbal, Wetzlinger, Auinger, & Wagner (2011)	empirical data - qualitative	Assessing the contribution of IS outsourcing to the triple bottom line performance.
25.	Harmon & Demirkan (2011b)	empirical data - qualitative	Providing IT managers with a progression map from traditional Green IT to corporate-wide sustainability.
26.	Erek, Loeser, Schmidt, Zarnekow, & Kolbe (2011)	empirical data - qualitative	Green IT strategy selection.
27.	Zhang *et al.* (2011)	empirical data - qualitative	Incorporating environmental considerations into the strategic planning of the IS engineering life cycle.
28.	Jeffers (2010)	empirical data - quantitative	IT investment decision-making for competitive advantage.
29.	Green Jr, Zelbst, Bhadauria, & Meacham (2012)	empirical data - quantitative	Assessment of environmental collaboration and monitoring on performance within supply chains.
30.	Benitez-Amado & Walczuch (2012)	empirical data - quantitative	The effect of IT capability on proactive corporate environmental strategies and firm performance.
31.	Molla *et al.* (2011)	empirical data - quantitative	Exploring and analysing the constructs for the Green IT readiness (G-readiness) of organisations.
32.	Molla (2009b)	empirical data - quantitative	Conceptualising Green IT and Green IT phenomena.
33.	Molla, Cooper, & Pittayachawan (2009)	empirical data - quantitative	Operationalising the key dimensions of Green IT readiness (G-readiness).

No.	Author/s, Year	Framework Basis	Framework Focus Brief
34.	Molla, Deng, & Corbitt (2010)	empirical data - quantitative	Assessing the maturity of the IT for green capability of IT organisations.
35.	Molla (2009a)	empirical data - quantitative	Classification of Green IT strategies and initiatives, and the assessment of Green IT adoption.
36.	Molla & Abareshi (2011)	empirical data - quantitative	Examining the eco-sustainability motivations that affect Green IT adoption.
37.	Schmidt, Erek, Kolbe, & Zarnekow (2010)	empirical data - quantitative	The predictors of Green IT adoption.
38.	Kuo (2010)	empirical data - quantitative	The organisational Green IT adoption factors.
39.	Meacham *et al.* (2013)	empirical data - quantitative	Information sharing indirectly impacts environmental performance through Green IS mediation.
40.	Gholami, Sulaiman, Ramayah, & Molla (2013)	empirical data - quantitative	Green IS adoption and its impact on environmental performance.

Table 1: Green IS and related frameworks

2.5.5.3 Summary

The objective of subsection 2.5.5 has been achieved by evaluating the existing Green IS and related frameworks. The evaluation reveals that none of the frameworks directly explicates the enabling and transforming capabilities of Green IS in terms of environmental sustainability. Therefore, development of the framework in this research is justified. In addition, none of the frameworks was developed with a mixed methods approach. The framework and methodology in this research make an original contribution to the academic body of knowledge and provide essential guidance and insight for environmental sustainability. The next section graphically presents the sensitising theoretical framework.

2.6 Sensitising theoretical framework

A theoretical framework is a conceptualisation of a particular complex research phenomenon, including the salient constructs and their interrelationships (Levy & Ellis, 2006). The objective of a theoretical framework is to enable understanding and expose the theoretical foundations of complex research phenomena through visual explication (Webster & Watson, 2002).

The sensitising theoretical framework presented in this section was based on the literature review only, and its purpose was to provide the researcher with sensitivity to the research domain. Notably, the sparseness of the sensitising theoretical framework, based on the literature, further exposed the need for this research to explicate, empirically, the enabling and transforming capabilities of Green IS for environmental sustainability.

Thus, the sensitising theoretical framework in this section provided sensitising constructs or points of departure only for the grounded theory part of this research (Charmaz, 2006). Subsequently, the grounded theory part of the research developed and explicated the framework from empirical data instead of the literature, to achieve the justified research objectives. Figure 1 below illustrates the literature-based sensitising theoretical framework.

Figure 1 below depicts two dependent concepts, namely internal and external strong environmental sustainability affected by two independent concepts, namely the enabling and transforming capabilities of Green IS. The two independent concepts affect the two dependent concepts through the demonstration of the mediating concept, namely fundamental business changes. In addition, there are three moderating concepts, namely environmental strategy and management, environmental information quality, and economic value. These three concepts directly influence how the two independent concepts affect the two dependent concepts.

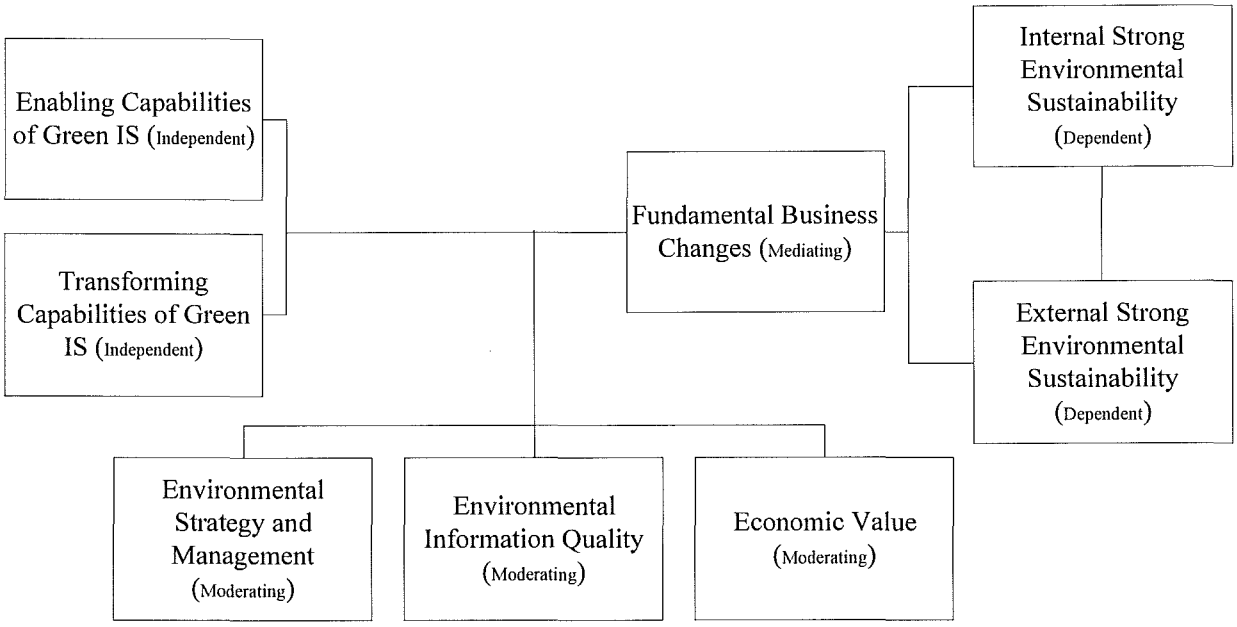

Figure 1: Sensitising theoretical framework

2.7 Chapter summary and conclusions

Chapter Two provided a systematic literature review and set the research in the context of relevant prior research. In addition, an analysis of the relevant concepts emerging from the literature was presented, which is the basis for demonstrating the ultimate contribution to the academic body of knowledge.

The objectives of Chapter Two have been fulfilled by detailing the systematic literature review process to support the claim of a rigorous literature review in subsections 2.2, 2.3, 2.4, and 2.5, substantiating the research problem and explaining how this research makes an original and significant contribution to the body of knowledge in subsections 2.5 and 2.6, exposing the most

influential researchers in the field throughout subsection 2.5, uncovering the key theories, variables, relationships, and phenomena throughout subsections 2.5 and 2.6, and developing a sensitising theoretical framework in subsection 2.6. Additionally, all of the objectives for each literature matrix concept subsection have been achieved, including answering the first research question: what is environmental sustainability and why is it important? This objective has been achieved in subsection 2.5.1 by fully elucidating the concept, establishing its significance, defining its fundamental principles, and uncovering its implications for organisations. Therefore, the goal of Chapter Two of developing a theoretical foundation for the research by way of a systematic literature review has been achieved.

In conclusion, Chapter Two provided convincing evidence of the obligation for environmental sustainability, the enabling and transforming capabilities of IS to achieve the necessary fundamental business changes, the weak degree of environmental sustainability in organisations, the key role of Green IS for environmental sustainability, and the corresponding requirement for leveraging the enabling and transforming capabilities of Green IS for environmental sustainability. In summary, the literature exposes the exigency for explicating the enabling and transforming capabilities of Green IS for environmental sustainability.

This chapter offers value to academics by way of an applied systematic literature review process. This process includes a systematic literature search strategy resulting in a rigorous literature review that forms the theoretical foundation of the research. In addition, it is established in the chapter that the research addresses an important research gap, and makes an original and valuable contribution to the academic body of knowledge by explicating the enabling and transforming capabilities of Green IS for environmental sustainability. Additionally, this chapter has substantial value for industry and organisations in that environmental sustainability is defined, contemporary organisational environmental strategies and management responses are uncovered, the role that Green IS plays in environmental sustainability is highlighted, and the need for guidance and insight to leverage the enabling and transforming capabilities of Green IS for environmental sustainability is elucidated.

The next chapter is Chapter Three, which provides the research methodology. Chapter Three begins with the determination of the high-level research strategy, including the ontological and epistemological assumptions that underpin the research, as well as the lower-levels of the research methodology. The research approach for answering the research questions and achieving the research objectives is developed.

Chapter 3: Research Methodology

3.1 Chapter introduction

Chapter Two provided a systematic literature review that developed the theoretical foundation for the research, exposed the most influential researchers in the field, and placed the research in the context of relevant literature. The research problem was substantiated, an explanation was given of how this research makes an original and significant contribution to the body of knowledge, and a sensitising theoretical framework was developed. Chapter Three provides the research methodology for addressing the research problem, achieving the research objective, and answering the research questions.

The goal of Chapter Three is to define and justify the research methodology. This goal is achieved through fulfilment of three objectives. These objectives are to establish the philosophical concepts underpinning the research, substantiate the research approach with reference to the research problem, research objective, and research questions, and clarify the subsequent research methods, especially the aspects of process, sampling, data collection, instrumentation, and data analysis.

Chapter Three continues with the determination of the research strategy. Thereafter, the philosophical concepts that support the research approach and define the lower levels of the research methodology are exposed. Subsequently, the research approach is justified and the ethics considerations are presented. Next, the chapter details the individual research methods. The chapter ends with a conclusions subsection.

3.2 Research strategy

Development of a research methodology begins with the high-level research strategy. This strategy departs on either a theoretical or an empirical path (Remenyi & Money, 2006). This research followed an empirical path, which involved collecting primary data in the field. The empirical path was required for the researcher to achieve the research objective.

In addition, the high-level research strategy involves the ontological and epistemological assumptions that underpin the research and that determine the lower-level implementations of the research methodology (Remenyi & Money, 2006). The next subsection, subsection 3.3, details the ontological and epistemological assumptions. Importantly, this research demonstrates rigour through the detailed explanations of the salient methodological, theoretical, and analytical decisions made; such explanations also establish the trustworthiness of the research (Skulmoski, Hartman, & Krahn, 2007).

3.3 Philosophical concepts

Ontology and epistemology are important philosophical concepts for research. Ontology is described as a view about the nature of the world, and epistemology is described as the ways people acquire knowledge about the nature of the world (Oates, 2006). In addition, ontology is described as the foundational beliefs about the world, and epistemology as a high-level reasoning process guiding empirical research (Lee, 2004). Thus, epistemology and ontology are fundamental to research, illuminating perceptions about the nature of the world and the acquisition of knowledge.

Furthermore, and specifically, epistemology involves questions relating to what knowledge is and how people acquire it, and encompasses the philosophical problem of how an absolute viewpoint can be obtained if people can never transcend their language and cultural systems. This philosophical problem and aforementioned questions indicate that knowledge is not infallible but it is conditional on societal or group acceptance, time, and place (Hirschheim, 1985). The epistemological response to the question of how people acquire knowledge introduces the conception of science, which can be viewed as conventions for discovering knowledge, which are also conditional on societal or group acceptance, time, and place (Hirschheim, 1985).

A relatively distinct dichotomy is evident when discussing both ontology and epistemology. This dichotomy contrasts positivism and interpretivism (Rocco *et al.*, 2003). Positivism relates to ontology about a natural world that exists independently of human perception and to epistemology where knowledge about this natural world is objectively obtained. Interpretivism relates to ontology about a natural world that is dependent on human perception and to epistemology where knowledge about this natural world is subjectively obtained (Chen & Hirschheim, 2004). Nevertheless, all perspectives on ontology and epistemology are questionable and malleable, and indeed, positivism and interpretivism can even be viewed as compatible and mutually supportive (Lee, 2004).

In particular, IS epistemology is analogous to social science epistemology because IS are ultimately social systems as opposed to technical systems (Hirschheim, 1985). Then social science epistemology, which advocates methodological pluralism, is appropriate for IS research (Hirschheim, 1985). Methodological pluralism departs from the extremes of positivism and interpretivism, supported by the pragmatist and the dialectical philosophical perspectives or positions (Rocco *et al.*, 2003). The pragmatist position views the extremes of positivism and interpretivism as logically independent, and therefore they can be mixed to best suit a particular research question (Greene & Caracelli, 1997). The dialectical position views the extremes of positivism and interpretivism as irreconcilable but valuable perspectives, to be used together for

the acquisition of deeper and broader knowledge (Greene & Caracelli, 1997). This research is IS research and it is philosophically based on both the pragmatist and the dialectical positions.

3.4 Mixed methods: research approach

3.4.1 Introduction

The lower-level implementations of the research methodology concern research approaches, research methods, or research tactics, and follow the high-level research strategy (Remenyi & Money, 2006). A research approach, method, or tactic is described as an evidence gathering and analysis approach for substantiating the claim of making a contribution to the body of knowledge (Remenyi & Money, 2006). This research uses the term research approach as a higher-level concept that subsumes the lower-level concepts of research method and research tactic. The research approach in this research answers the research questions and enables fulfilment of the research objective, as detailed in Chapter One.

Following both the pragmatist and the dialectical positions, the research approach was the mixed methods approach. Within this approach, two research methods were employed. Each of these methods was selected based on their appropriateness for answering a particular research question and achieving a particular research sub-objective. Importantly, the research objective and research questions could be answered by only one research method (Leech & Onwuegbuzie, 2009; Creswell, 2009).

Notably, a mixed methods approach can be implemented at any point during a research project, in any sequence, at any level of analysis, in any proportion, with any tools or techniques, and with qualitative and quantitative data and analysis (Rocco *et al.*, 2003). Furthermore, objectives of the mixed methods approach include triangulation for increasing validity and interpretability, and corroborating research inferences (Oates, 2006); complementarity for measuring phenomena more completely, development for informing other methods, tools, or techniques, and expansion for widening scope (Rocco *et al.*, 2003).

3.4.2 Justification

A great strength of IS research is that it can accommodate both qualitative and quantitative approaches in a single study (Venkatesh, Brown, & Bala, 2013). The mixed methods approach in this research integrates thematic and statistical data to produce a comprehensive technique for research in social sciences (Jogulu & Pansiri, 2011). This approach enables both exploratory inductive and confirmatory deductive research logic without detracting from either (Jogulu & Pansiri, 2011; Rocco *et al.*, 2003). The mixed methods approach prevents over-reliance on

statistical data to explain social phenomena, which are subjective in nature (Jogulu & Pansiri, 2011).

Importantly, the mixed methods approach addresses the problem of inherent bias that exists in any one particular approach (Rocco *et al.*, 2003). It mitigates the limitations of a single research approach, benefits from different epistemological perspectives, has greater applicability to complex organisational contexts, and makes a more significant contribution to scholarly and practical knowledge (Davison & Martinsons, 2011). Furthermore, the mixed method approach is encouraged in doctoral research because the researcher develops skills in two dominant methods (Jogulu & Pansiri, 2011; Davison & Martinsons, 2011; Gable, 1994). In addition, the combination of qualitative and quantitative methods of data collection and analysis provides the required richness in IS research (Kaplan & Duchon, 1988), develops greater insights for strengthening the research findings, improves the accuracy of inferences, and increases credibility (Jogulu & Pansiri, 2011).

Some of the challenges in using a mixed methods approach include the inconsistent use of mixed method terminology within and across disciplines, the possibility of contradictory interpretations of data from each subsequent research approach (Petter & Gallivan, 2004), and the additional time and resources required to use more than one research method. The researcher has addressed these challenges by carefully explaining and defining the terminology used, using any contradictory data interpretations to create deeper insights, and planning for the additional time and resources required for the benefit of a more significant contribution to the body of knowledge.

3.4.3 High-level process

Figure 2 below depicts the high-level research approach followed in this research.

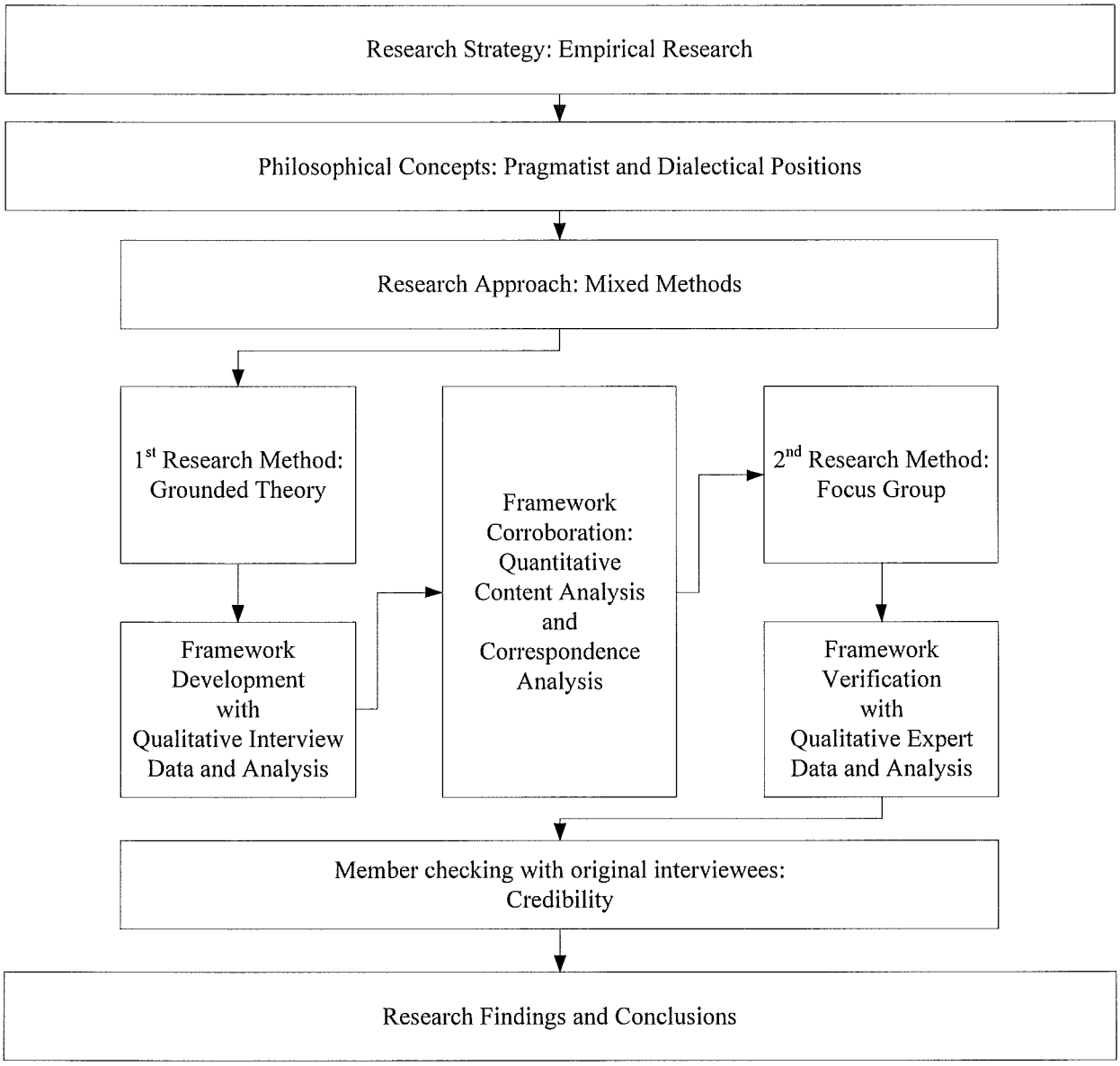

Figure 2: High-level research approach

3.4.4 Ethical clearance

Research ethics is a paramount and mandatory consideration in any research undertaking (NWU, 2010). It considers what is right or wrong in research conduct (Mouton, 2001; Bhattacherjee, 2012). Furthermore, it is concerned about how people, such as the participants, are affected by research in addition to how research affects the organisations involved in the research. Research ethics dictates that no one is harmed in any way, either physically, psychologically, or emotionally, and that each person is treated fairly and with dignity (Oates, 2006; Mouton, 2001). This is described in terms of participants' rights, being the right to privacy, the right not to

participate, the right to withdraw, the right to give informed consent, the right to anonymity, and the right to confidentiality (Oates, 2006; Mouton, 2001).

Additionally, research ethics is described in terms of the researcher's responsibilities, namely no unnecessary intrusion, behaving with integrity, and following appropriate professional codes of conduct (Oates, 2006). In addition, it requires objectivity and integrity, no fabrication or falsification of data, recording of own data, ethical publishing practices involving appropriate ascription of authorship to a publication, rejection of any form of plagiarism, no simultaneous submission of manuscripts, and accountability to society, the scientific community, and the environment (Mouton, 2001). Furthermore, research ethics concerns the confidential and secure storage and use of the research data and records (Myers & Newman, 2007; NWU, 2010). This research adheres to the aforementioned research ethics requirements, which are detailed in the ethics approval form that was submitted to the Research Ethics Committee at NWU in South Africa, and subsequently approved by the same committee on 15 April 2013 (NWU Ethics approval no: NWU-00138-12-A9). In addition, ethics clearance was obtained from UNISA on 25 February 2014.

3.5 Grounded theory: first research method

3.5.1 Introduction

Research based on interpretivism enables deep insights into IS phenomena through the understanding of human thought and action in both organisational and social contexts (Klein & Myers, 1999). The grounded theory method is consistent with this purpose of interpretivism, and is appropriate for IS research (Urquhart, Lehmann, & Myers, 2010; Urquhart, 2001). The first research method was the grounded theory method, being a research method that was very well suited to the sub-objective of developing a framework (Charmaz, 2006). Indeed, grounded theory is focused on theory development (Corbin & Strauss, 2008; Glaser & Strauss, 1967), contrasting it from other research approaches (Butler & O'Reilly, 2010) such as the hypothetico-deductive approach that is suited to testing existing theories (Rodon & Pastor, 2007). Therefore, this method was implemented in this research to answer the second research question: how do the enabling and transforming capabilities of Green IS manifest and relate to environmental sustainability?

Grounded theory was first published in 1967 by Barney Glaser and Anselm Strauss, who stated that the purpose of grounded theory is the discovery of theory from systematically collected and analysed data (Glaser & Strauss, 1967). Apart from the grounded theories of Glaser and Strauss, this research also followed the grounded theory of a leading contemporary grounded theorist, practitioner of grounded theory, and former student of both Glaser and Strauss, namely Kathy

Charmaz (Charmaz, 2006). Charmaz's grounded theory has evolved to accommodate present-day methodological thinking while being firmly based on the original grounded theory thinking (Charmaz, 2006). In addition, the grounded theory in this research is complemented by relevant grounded theory research published in quality IS publications.

3.5.2 Justification

Grounded theory is appropriate when there is no existing theory suitable to address the specific research problem, the complexities of the organisational context are essential to address the specific research problem, and the research problem involves organisational transformation (Orlikowski, 1993). These conditions applied to this research. Furthermore, grounded theory is suited to uncovering process and change in organisational contexts (Urquhart & Fernandez, 2006).

Grounded theory is also suitable for developing frameworks for managers and where research requires a theoretically dense explanation (Bakir & Bakir, 2006). In addition, it provides sociological insight, clarifies complexity, uncovers conceptual elusiveness, and discovers relevant concepts and relationships (Bakir & Bakir, 2006). Furthermore, grounded theory provides practitioners with deep theoretical insight based on empirical knowledge for improved decision-making (Fernandez, Lehmann, & Underwood, 2002). Notably, it is suited to generating new insights about socio-technical systems and testable theory, and is widely used and recognised in the IS discipline (Rodon & Pastor, 2007).

Grounded theory has clear data collection and analysis procedures that are helpful for novice researchers (Urquhart & Fernandez, 2006; Rodon & Pastor, 2007). Its well-established analysis procedures include constant comparison and iterative conceptualisation, which support the emergence of original theory that is intimately linked to the data. This allows IS researchers to confidently develop new and empirically grounded theories of IS phenomena (Orlikowski, 1993; Urquhart *et al.*, 2010). Furthermore, grounded theory's coding method has great potential for developing theories that significantly contribute to the IS discipline (Urquhart & Fernandez, 2006). Importantly, grounded theory develops the essential building blocks of all IS theories, being concepts and their relationships, through categories and theoretical coding, and provides the platform for theories in IS to engage with theories in other disciplines (Urquhart *et al.*, 2010).

Theories developed with grounded theory are developed directly from the data, which negates the necessity for additional justification and testing (Allan, 2003). Moreover, grounded theory has empirical validity (Orlikowski, 1993; Rodon & Pastor, 2007) and relevance through its intimacy with the data, rigour through clearly formulated analysis and theory generating procedures, and strength through its flexibility in unexplored domains and its suitability for IS

research (Urquhart & Fernandez, 2006). In addition, formative validity, an attribute of the theory building process, is achieved in grounded theory by ensuring that theoretical constructs emerge from the data only, instead of being derived from published theory (Lee & Hubona, 2009). Additionally, its use of theoretical sampling provides theoretical relevance and density (Urquhart *et al.*, 2010).

3.5.3 Reviewing the literature

Grounded theory supports reviewing the literature before conducting empirical data collection. However care must be taken not to allow the existing theories in the literature to distort any emerging theory, which must be grounded in the empirical data and not in the literature (Glaser & Strauss, 1967; Corbin & Strauss, 2008; Charmaz, 2006; Urquhart *et al.*, 2010). Indeed, the literature is important for gaining theoretical sensitivity to the salient concepts and contexts concerning the research (Glaser & Strauss, 1967; Allan, 2003; Urquhart & Fernandez, 2006; Rodon & Pastor, 2007; Urquhart *et al.*, 2010).

3.5.4 Sampling

In grounded theory, it is not possible to predetermine, prescribe, preplan, or predefine samples for data collection; instead, grounded theory uses theoretical sampling which determines samples as the research continues (Glaser & Strauss, 1967; Corbin & Strauss, 2008; Charmaz, 2006; Rodon & Pastor, 2007; Urquhart *et al.*, 2010). Theoretical sampling is not about achieving statistical generalisability; it is about fitting emerging theories with data (Charmaz, 2006). Theoretical sampling allows the discovery of theory through the development of categories, category properties, and their interrelationships (Glaser & Strauss, 1967; Corbin & Strauss, 2008; Charmaz, 2006). It is systematic, strategic, and specific (Charmaz, 2006), facilitates theoretical comprehensiveness, and ensures that the emergent theory is grounded in the data (Urquhart *et al.*, 2010).

Theoretical sampling determines samples and interview questions based on their theoretical relevance for furthering the development of the emerging theory. It is based on the theoretical purposes of maximising or minimising both differences and similarities in the data for furthering the development of the emerging theory (Glaser & Strauss, 1967; Corbin & Strauss, 2008; Charmaz, 2006; Orlikowski, 1993).

Theoretical sampling is essentially controlled by the emergent theory (Glaser & Strauss, 1967; Corbin & Strauss, 2008; Charmaz, 2006). The exception is the first theoretical sample, which occurs before there is any emergent theory, and this sample is determined by the researcher's general theoretical sensitivity to the research context (Glaser & Strauss, 1967; Corbin & Strauss, 2008; Charmaz, 2006). Thereafter, theoretical sampling occurs together with data collection,

coding, and analysis in order to develop emergent theory; importantly, none of these activities are isolated, sequential processes (Glaser & Strauss, 1967; Corbin & Strauss, 2008; Charmaz, 2006). In addition, memo writing directs theoretical sampling by exposing incomplete categories and gaps in the analysis (Charmaz, 2006).

The quality of theoretical sampling is judged by the breadth and diversity of the selected samples, in the saturation of the categories, and by the quality of the emergent theory (Glaser & Strauss, 1967; Corbin & Strauss, 2008; Charmaz, 2006). This sampling terminates once theoretical saturation is achieved, which means that no additional data is being found that further develops the categories, category properties, and their interrelationships (Glaser & Strauss, 1967; Corbin & Strauss, 2008; Charmaz, 2006; Orlikowski, 1993).

In order to obtain data about an organisation, it is necessary to access specific people that are key informants or relevant proxies for the organisation (Bhattacherjee, 2012). Therefore, the key informant approach is used. This is an established approach in empirical organisational research, and obtains data from individuals that are most likely to have strategic and management knowledge that is relevant to the research (Kim, Shin, & Grover, 2010; Yang, 2005; Nelson & Cooprider, 1996).

3.5.5 Data collection

Grounded theory does not advocate any specific data collection technique or method (Glaser & Strauss, 1967). The technique used was semi-structured face-to-face interviews. Interviews are a well-established and useful means of qualitative data collection in interpretive, grounded theory, and IS research (Charmaz, 2006; Myers & Newman, 2007; Schultze & Avital, 2011; Rodon & Pastor, 2007; Bakir & Bakir, 2006). Indeed, interviews are particularly useful for obtaining insight where interview participants have the relevant experiences to convey that insight (Charmaz, 2006; Allan, 2003). Grounded theory is suited to interviews with few broad, open-ended questions such as questions that begin with how, what, and when. These types of questions allow an interviewee to reflect on relevant phenomena, allow an interviewee's story to emerge, and elicit rich data (Charmaz, 2006; Kendall & Kendall, 1993). Essentially, grounded theory interview questions are shaped to obtain rich data while avoiding the imposition of preconceived concepts on the data (Charmaz, 2006).

Importantly, the interviews facilitated rich data generation by grounding the interview in the interviewee's own experiences, acknowledging and valuing the interviewee's narrative reconstruction of his/her experiences, and providing an explicit structure in the form of an interview guide for guiding the interviewee's articulation and interpretation of his/her experiences (Schultze & Avital, 2011).

Interview questions can be based on concepts from the literature, common sense knowledge and the researcher's own theoretical sensitivity and experiences (Bakir & Bakir, 2006). As a grounded theory interview conversation proceeds, it is important for the interviewer to pursue leads with additional focused, clarification, and elaboration questions (Charmaz, 2006). In this regard, probes and prompts can be effective; probes are questions that get an interviewee to expand on a response and may even include patches of silence; and prompts are questions to ensure that interviewees answer completely (Hove & Anda, 2005). Semi-structured interviews require flexibility, improvisation, and openness (Myers & Newman, 2007). Furthermore, it is necessary to pay attention to nuances in interviewee responses, as these can indicate assumptions, articulation difficulties, or specific meaning (Charmaz, 2006).

Interviewer self-reflection and self-awareness are important for understanding and managing the effect of the interviewer's identity, emotions, and judgements on the interviews (Corbin & Strauss, 2008; Charmaz, 2006). An equally important aspect is sensitivity to the notion that the researcher's findings are a product of the data and the researcher, and to grasp the interviewees' meanings of salient issues, events, and occurrences (Corbin & Strauss, 2008).

During an interview, the interviewer actively listens with sensitivity while an interviewee does the talking (Charmaz, 2006). Making use of a recorder during an interview allows the interviewer to give an interviewee his/her full attention, allows the interviewer to maintain eye contact, and provides the researcher with detailed data (Charmaz, 2006; Rodon & Pastor, 2007).

Good interviewer conduct includes providing the interview questions in advance for interviewee preparation, creating an atmosphere of trust and rapport, ensuring confidentiality, explaining the interview objectives and the research objectives, explaining how the data will be used, phrasing questions in a non-threatening manner, mirroring or utilising the interviewee's words or phrases in subsequent questions, allowing the interviewee to talk freely, actively listening, asking for permission to record the interview, dressing in accordance with the organisation's acceptable dress code, encouraging silent interviewees, and managing interviewees that talk too much (Hove & Anda, 2005; Myers & Newman, 2007).

A disadvantage of interviews is that they are resource intensive, demanding time-consuming planning, execution, and analysis (Hove & Anda, 2005). The resource-intensive interview planning activities include selecting interviewees and scheduling appointments, collecting background information about interviewees and their organisations, and preparing interview guides (Hove & Anda, 2005). In addition, it can take about eight hours to transcribe just one hour of audio recording (Hove & Anda, 2005). For this research, the researcher had the necessary time to complete these activities.

Other interview challenges include establishing the necessary trust between the interviewee and the interviewer who are usually complete strangers, collecting sufficient data within the interview time constraints, preventing ambiguities in questions, and not unintentionally offending an interviewee (Myers & Newman, 2007). The researcher addressed these challenges during interviews by establishing a rapport with each interviewee through informal chat before the interview and through the introductory part of the interview, following the interview guide at each interview, testing the interview guide beforehand and articulating questions clearly, and being non-judgemental, sensitive, courteous, respectful, and not expressing dismay or disagreement. Furthermore, the researcher dressed in a suit and tie, which is common attire for banking management; this created an acceptable first impression and one that the interviewees could easily relate to.

3.5.6 Pretest

Annexure B provides the interview guide, which sets out the key interview questions. These questions answered the second research question and covered all the aspects in the sensitising theoretical framework, while not making any assumptions about these aspects or their interrelationships.

The interview guide was pretested as part of the interview preparation. The purpose of the pretest was to uncover any practical, format, wording, or grammatical flaws, limitations, or other weaknesses, so that any refinements could be made before the research commenced (Turner III, 2010). The interview guide was pretested with an interviewee selected by convenience sampling in the banking sector. This type of sampling is suitable for its purpose, which is to pretest the interview guide and not to analyse any data. Notably, the pretest is not a pilot study, which is a small-scale version of a full study, applied in the same way as the full study, including data analysis. The pretest was conducted with an interviewee at vice-president level in an international bank based in South Africa. In addition, the theoretical sampling process and the semi-structured nature of the interviews assisted to strengthen the interview guide.

3.5.7 Data analysis

3.5.7.1 Principles

Grounded theory development is dependent on the interplay between induction, which includes the derivation of concepts and their properties from the data and deduction, which includes deriving relationships between the concepts (Corbin & Strauss, 2008). In addition, grounded theory development is interpretive and involves organising data into emergent concepts and organising concepts into a logical, systematic explanatory scheme through emergent statements of relationship (Corbin & Strauss, 2008; Charmaz, 2006; Glaser & Strauss, 1967). It is important

to never lose sight of the data, to always work with the properties of concepts for focus on data differences and similarities, and to grasp what the interviewees are saying about an event instead of applying the researcher's own perceptions of that event (Corbin & Strauss, 2008).

Grounded theory data analysis gives meaning to the data, by breaking up the data, conceptualising or coding it, and developing those concepts through elaborated properties (Corbin & Strauss, 2008). Coding is the pivotal link between data collection and the development of an emergent theory; the codes become the elements of a nascent theory that explains the data and directs theoretical sampling (Charmaz, 2006). Concepts are core to data analysis and are the researcher's conceptual interpretation of what is occurring in the data (Corbin & Strauss, 2008). Concepts vary in abstraction, and lower-level concepts provide the detail for higher-level or more abstract concepts or categories and ground the categories in the data (Corbin & Strauss, 2008). Properties are characteristics that define and describe concepts (Corbin & Strauss, 2008). Categories must be abstract and dense, which refers to the full inclusion of salient properties (Corbin & Strauss, 2008), and a category must stand by itself as an element of theory (Glaser & Strauss, 1967).

The main data analysis strategies are constant comparison and questioning (Corbin & Strauss, 2008). Constant comparison is central to grounded theory, imperative throughout data analysis, establishes analytic distinctions, and occurs within and across data, codes, categories, and concepts to uncover differences and similarities (Charmaz, 2006; Glaser & Strauss, 1967; Urquhart *et al.*, 2010). Constant comparison allows the researcher to differentiate concepts and develop their properties and dimensions (Corbin & Strauss, 2008). Questioning and reflecting on the range of possible answers allows the researcher to probe into the data, better understand the data from the interviewee's perspective, develop concepts, and guide theoretical sampling (Corbin & Strauss, 2008). Questioning examples are (Allan, 2007; Rodon & Pastor, 2007): What is this data a study of? What concept or category does this incident indicate? What is actually happening in this data? And what patterns are occurring in the data? It is imperative in grounded theory to iteratively and jointly perform data collection, coding, and data analysis, and to use constant comparison and theoretical sampling (Glaser & Strauss, 1967; Orlikowski, 1993; Urquhart *et al.*, 2010).

3.5.7.2 Process

Initially, data analysis is detailed in order to explore all the possible interpretations; thereafter, it becomes more general in order to develop the interpretations (Corbin & Strauss, 2008; Urquhart *et al.*, 2010). Initial data analysis involves open or initial coding or the process of defining the data, which categorises, summarises, and accounts for every data segment (Corbin & Strauss,

2008; Charmaz, 2006; Orlikowski, 1993). Initial coding breaks down data segments and assigns each segment with a concise qualitative code that may consist of one or many terms; these initial codes provide analytic handles for developing abstract concepts or theoretical categories and facilitate the emergence of meaning from the data (Charmaz, 2006; Rodon & Pastor, 2007).

During initial coding the researcher is strictly consistent with the data or is grounded in the data, avoids pre-existing or preconceived theory and codes, acknowledges that the researcher's view is only one of many, remains open to all possible theoretical directions indicated by the data, keeps codes short, precise, and simple, uses codes that reflect actions, and uses gerunds to detect processes and adhere to the data (Charmaz, 2006). The initial codes are provisional as the researcher remains open to other analytic possibilities and improved codes (Charmaz, 2006). Initial coding is flexible about the unit of data to code, which can be a word, a line of words, or an incident. In particular, line-by-line coding forces the researcher to define what is happening in the data, the implicit processes, and to uncover nuances in the data. Incident coding facilitates pattern and contrast discovery (Charmaz, 2006). In addition, initial coding may include in vivo codes, which are the special terms used by interviewees. These codes can lead to the discovery of deeper insight and meaning, and embed the researcher in an interviewee's world (Charmaz, 2006).

Focused coding follows initial coding and uses the most prominent or frequent codes to sort, synthesise, integrate, and organise the data. These codes are more conceptual, directed, and selective and they develop categories (Charmaz, 2006). Thereafter, theoretical coding develops and specifies relationships between categories and begins the development of a coherent grounded theory (Charmaz, 2006; Urquhart *et al.*, 2010). Coding is an iterative process where the researcher can go back to any point and recode as the emergent theory dictates (Charmaz, 2006). A final step in data analysis is integration, which involves linking categories around core categories and refining the resultant theoretical construction into a logical, systematic explanatory scheme (Corbin & Strauss, 2008).

Axial coding determines the properties of categories, forms relationships among initial codes and relates categories to sub-categories (Charmaz, 2006; Corbin & Strauss, 2008). However, it may stifle grounded theory development by forcing a particular frame of analysis on the data, and theoretical coding negates the need for axial coding (Charmaz, 2006).

Memos are vital throughout data analysis; they record and develop the researcher's analytic insights (Corbin & Strauss, 2008; Allan, 2007). Memo writing is the core of any grounded theory, facilitates discovery, and is the key step between data collection and writing drafts of papers (Charmaz, 2006). It actively engages the researcher with the data, increases the level of abstraction of ideas, crystallises questions, and directs subsequent theoretical sampling

(Charmaz, 2006). Memos are narrative statements that explain properties, conditions, consequences, and relationships and raise focused codes to conceptual categories (Charmaz, 2006). Memos are informal, spontaneous, analytic notes, written in unofficial language, and record what the researcher understands is happening in the data (Charmaz, 2006). Additionally, this research made use of computer software called Atlas.ti (ATLAS.Ti, n.d.) to support the grounded theory data analysis activities.

3.5.8 High-level process

Figure 3 below depicts the high-level grounded theory method that was followed.

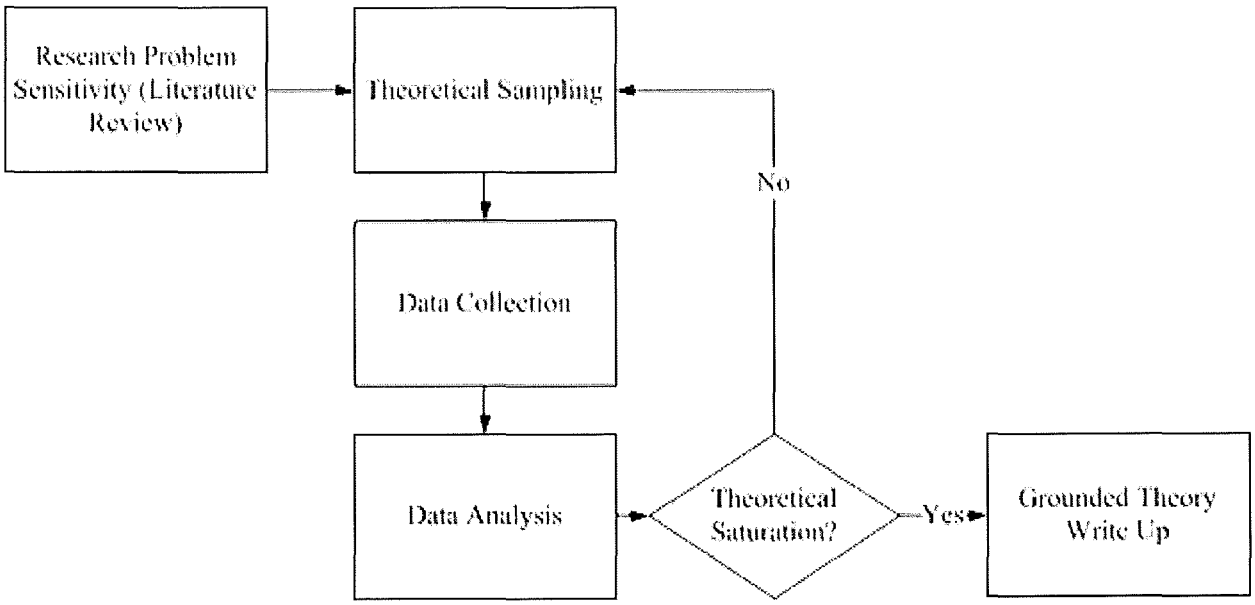

Figure 3: High-level grounded theory method

3.6 Quantitative analysis: framework corroboration

3.6.1 Introduction and justification

In accordance with the mixed methods research approach adopted and justified in this research, the qualitative grounded theory results were further analysed quantitatively using content analysis and correspondence analysis. The combination of qualitative and quantitative methods of data collection and analysis provides the required richness in IS research (Kaplan & Duchon, 1988) and develops greater insights for strengthening the research findings, improving the accuracy of inferences, and increasing credibility (Jogulu & Pansiri, 2011). Furthermore, such triangulation increases validity, interpretability, corroborates research inferences (Oates, 2006) and measures phenomena more completely (Rocco *et al.*, 2003).

3.6.2 Content analysis

Content analysis has been used successfully to analyse textual responses of research participants in IS research (Venkatesh *et al.*, 2013; Siponen & Vance, 2010; Bhattacherjee & Premkumar, 2004) and is valuable for facilitating theory elaboration (Ceci & Iubatti, 2012). In particular, content analysis provides triangulation and validation of the findings from the grounded theory analysis and additional insights into the concepts and their interrelationships (Bhattacherjee & Premkumar, 2004).

Content analysis is an approach to the analysis of texts and documents, including interview transcripts, and aims to objectively quantify the content in terms of predetermined categories in a replicable and systematic way (Bryman & Bell, 2011; Ceci & Iubatti, 2012). This analysis is objective because it is transparent in its procedures for assigning data to categories, it is systematic because the rules are applied in a consistent manner, and it is replicable because any researcher can employ the same rules to achieve the same results. These aspects of content analysis mitigate personal researcher bias (Bryman & Bell, 2011; Ceci & Iubatti, 2012).

3.6.3 Correspondence analysis

3.6.3.1 Introduction and justification

The term 'correspondence analysis' is a direct translation of its original French term *analyses des correspondances*, which means a system of associations between sets of variables, with the objective of facilitating interpretation with a global view of the data (Lee, 1996). Correspondence analysis complements content analysis by providing a perceptual map of the multivariate data in order to substantiate findings, corroborate theoretical interpretations, and facilitate deeper understanding (Remenyi, 1992). It provides a statistical visualisation of the associations within a two-way contingency table (Lee, 1996). Importantly, this analysis is suited to social science research, which is consistent with IS research, and especially appropriate for categorical data in a contingency table (Greenacre & Lewi, 2009; Greenacre, 2006; Phillips, 1995). The only data requirement for correspondence analysis is a two-way contingency table with non-negative data elements, such as the contingency table produced during the content analysis phase (Nagpaul, 1999).

Correspondence analysis provides an appropriate means for exposing systematic relationships between variables. It greatly simplifies complex data while accounting for all information in the data (Nagpaul, 1999; Phillips, 1995) by reducing the dimensionality of a data matrix to produce a graphic in a low dimensional subspace, usually a two-dimensional subspace or two axes (Nenadic & Greenacre, 2007). Correspondence analysis illustrates the nature of the relationships between variables, and not just that there are relationships (Nagpaul, 1999).

3.6.3.2 Process

Correspondence analysis is essentially a variation of weighted principal components analysis (Greenacre, 2006). The main concepts are profile, mass, and chi-square distance (Remenyi, 1992). This type of analysis begins by examining the row and column profiles, based on the relative frequencies for each element in the contingency table (StatSoft, 2013). Additionally, determining the row and column profiles produces a mass value for each row and each column, such that a row's mass is its row margin relative to the table's grand total, and a column's mass is its column margin relative to the table's grand total (Greenacre, 2006). Chi-square distance is the defined distance between profiles, being a squared difference between profiles incorporating mass (Greenacre, 2006; Greenacre & Lewi, 2009).

Another important concept in correspondence analysis is inertia, which is a variability measure of the row and column profiles in their respective spaces (Greenacre, 2006). Profile points form a cloud of profile points summing to one; they have a centroid, which is the average profile; they have a distance, which is the chi-square distance; and each profile point contributes to the whole cloud's inertia (Nagpaul, 1999). Correspondence analysis works out the principal axes of inertia, including the eigenvalue for each of these axes, which is equivalent to the inertia of the cloud in the direction of each axis (Nagpaul, 1999).

3.7 Focus group: second research method

3.7.1 Introduction

In order to verify the framework developed during the grounded theory phase of the research and corroborated through content and correspondence analysis, a focus group with expert informants was conducted. This provided conclusive evidence from knowledgeable and professional practitioners in the field for verification of the developed framework (Rosemann & Vessey, 2008). The focus group method is consistent with the purpose of interpretivism and is appropriate for IS research (O'hEocha, Wang, & Conboy, 2012; Tremblay, Hevner, & Berndt, 2010). Therefore, this method was implemented to answer the third research question: according to experts, does the Green IS framework successfully capture the essential Green IS concepts and interrelationships to be relevant for environmental sustainability?

The main elements of the focus group method are the specific topic focus, group interaction, and rich data (O'hEocha *et al.*, 2012). Essentially, the focus group method gathers data on a specific research topic through the interaction of a group of expert participants, where the participants interact with and react to one another as a moderator presents the questions on the topic and facilitates the interactions (Sutton & Arnold, 2013). Importantly, it is the group interaction and

discussions that allow valuable insight and normally inaccessible data to emerge (O'hEocha *et al.*, 2012).

Nevertheless, the focus group method requires extensive effort, time, and financial cost on the part of the researcher, in terms of accessing and gaining commitment from experts and a moderator, accessing and scheduling a venue and related infrastructure, travelling to the venue, administering the session, transcribing the audio recording, analysing and interpreting the resulting data, and reporting back findings to the participants (Sutton & Arnold, 2013).

3.7.2 Justification

The focus group method is appropriate for testing frameworks (O'hEocha *et al.*, 2012; Rosemann & Vessey, 2008; Soni & Kodali, 2013), especially from the view that the framework is an artefact with potential use in industry and by the expert participants (Tremblay *et al.*, 2010). Furthermore, the focus group method is ideal for ensuring research relevance through evaluation of the research artefact by experts in the field, and provides evidence of the research artefact's impact (Rosemann & Vessey, 2008).

The focus group method provides a group environment that facilitates a common understanding of a new theory or framework, supports lively discussions, allows joint exploration of new concepts, contributes to a sense of joint ownership of findings and recommendations, and yields plentiful and rich data (O'hEocha *et al.*, 2012). Additionally, this method provides a free-flowing, flexible format that elicits unstructured, spontaneous, and genuine responses on a particular topic, resulting in dependable data (Sekaran & Bougie, 2009; Bryman & Bell, 2011).

In addition to accessing experts who hold unique and relevant knowledge about the intricacies of the research phenomena (Sutton & Arnold, 2013), it is the synergistic effects of the participant interactions that yield the important shared perceptions and insights, which can exceed the sum of individual interviews (Belanger, 2012). Importantly, the focus group method is highly effective in facilitating unstructured group discussion for achieving a group consensus or a majority view (Sutton & Arnold, 2013), which supports verification. Thus, the focus group method is suitable for verification because it provides competent evidence from experts.

3.7.3 Sampling

Usually focus groups consist of eight to ten expert participants (Sekaran & Bougie, 2009; Sutton & Arnold, 2013). Participants are selected for the focus groups based on their expertise relating to the topic (Sekaran & Bougie, 2009), which is required for validity (Belanger, 2012). Notably, in addition to having expertise relating to the topic, participants should have some diversity in their knowledge and experience to enhance insight (Sutton & Arnold, 2013). Nevertheless,

participants must be relatively compatible for high levels of participation and interaction (Belanger, 2012).

The process employed in selecting appropriate experts ensures validity, improves confidence in the findings for researchers and practising managers, results in a reliable and validated data collection process, enhances rigour, and is an efficient method for advancing the IS body of knowledge. Experts are the data source in the focus group because they serve as memory for what has occurred in the past, including why and how decisions have been reached, they have a deep understanding of the salient issues, and they can appropriately evaluate the quality of new concepts. Experts apply insight, authority, and knowledge to the research problem and are typically employees with extensive experience or consultants. Indeed, the collective voice of experts can be regarded as being representative of what other similar experts think about the topic (Belanger, 2012). In addition, experts reflect contemporary perspectives and deep knowledge relevant to the research.

Importantly, sampling is purposive in order to obtain participants with a thorough understanding and knowledge of the topic (Carey & Asbury, 2012). The objective of the focus group method is not statistical representativeness or generalisability (Carey & Asbury, 2012); instead, it is analytical generalisability and applicability that is the objective. Analytical generalisability and applicability of the findings to many settings and contexts is obtained by the provision of data from experts, who have extensive experience of many relevant settings and contexts (Belanger, 2012). Furthermore, in this research internal validity was addressed by providing an extensive and detailed account of the focus group process and data interpretation and relevance was achieved by engaging experts in the field (Belanger, 2012).

3.7.4 Data collection

3.7.4.1 Researcher's role: observer and note taker

The researcher does not take an active role in the focus group; this is important to prevent bias. The researcher's role during the focus group session is to do the necessary administration, personally thank the participants, and perform an observer and note taker role (Tremblay *et al.*, 2010). This role involves gathering data relating to the group interaction that cannot be captured on audio recording, and to gathering data if the audio recorder fails.

3.7.4.2 Moderator

The moderator is a critical feature of the focus group method (Sekaran & Bougie, 2009). The moderator's role is to conduct the focus group session by introducing the topic, leading and steering the group discussions to gather relevant data, and helping to bridge any interruptions or

problems in the flow of the group discussions. In addition, the moderator is to ensure that all participants contribute and that no participants dominates the discussions (Belanger, 2012).

Skills and traits required by the moderator include respect for all participants, the ability to ensure that all participants express their views, the ability to involve all participants in discussions, the ability to communicate clearly, listen effectively and control personal views to prevent introducing personal bias, a sense of humour and a friendly manner, an appropriate understanding of the research topic and questions, and time management to ensure that the topic agenda is covered as planned (Tremblay *et al.*, 2010).

These skills are vital for negating the potential problems that may occur in focus groups. These are inhibition of some of the participants, diversions to social discussions completely off the topic, conforming behaviour that stifles diverse views (Sutton & Arnold, 2013), polarisation of the group into several sub-groups causing sub-group views instead of individual views, and dynamics that stifle controversial views (O'hEocha *et al.*, 2012).

3.7.4.3 Topic agenda

A detailed topic agenda or plan of the focus group session is an imperative (Carey & Asbury, 2012; Bryman & Bell, 2011). The topic agenda, in Annexure C, sets the direction for the focus group session and aligns it with the research objective and research questions (Tremblay *et al.*, 2010). Attention to the physical setting for a focus group is very necessary. This includes ensuring that participants are in a relaxed atmosphere without distractions and seating where participants can see one another and feel like they are equals in the session (Belanger, 2012; Tremblay *et al.*, 2010).

3.7.5 Pretest

The topic agenda is pretested as part of the focus group preparation; the pretest's purpose is to uncover any practical, format, wording, or grammatical flaws, limitations, or other weaknesses, so that any refinements can be made before the session commences. The topic agenda for the focus group was pretested with an interviewee at vice-president level in an international bank based in South Africa selected by convenience sampling. This type of sampling is suitable for its purpose, which is to pretest the topic agenda and not to analyse any data. Notably, the pretest is not a pilot study, which is a small-scale version of a full study, applied in the same way as the full study, including data analysis.

3.7.6 Data analysis

Grounded theory analysis is commonly used to analyse focus group data (Carey & Asbury, 2012). Therefore, the grounded theory analysis that is detailed in the grounded theory part of this

chapter was appropriately used for the analysis of the focus group data. Following this, Atlas.ti (ATLAS.Ti, n.d.) was used to support the focused group data analysis activities (Belanger, 2012). Importantly, the analysis was performed with regard to the questions posed to the focus group participants and included analysing the interaction effects among the group participants (Carey & Asbury, 2012).

3.7.7 High-level process

Figure 4 below depicts the high-level focus group method followed in this research.

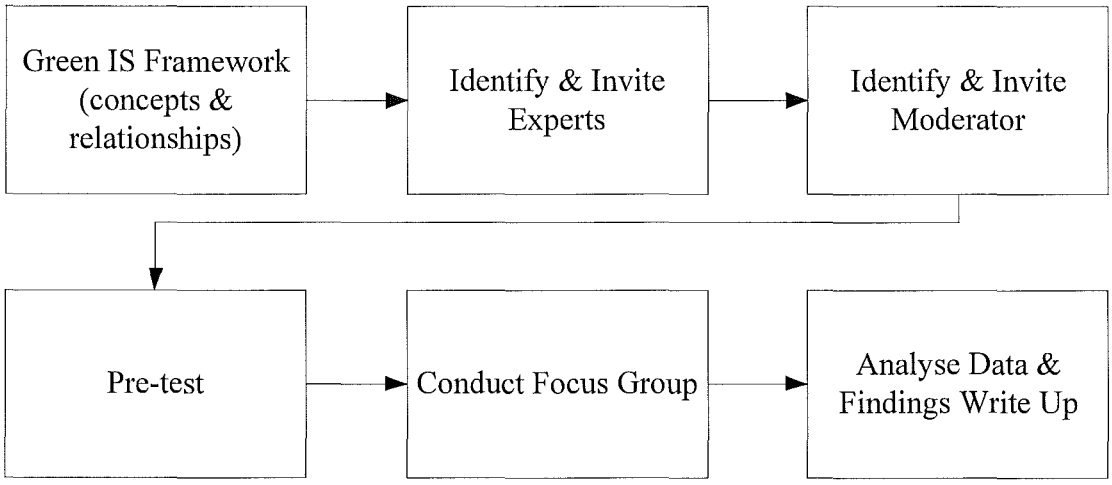

Figure 4: High-level focus group process

3.8 Member checking

Following the focus group method, member checking was conducted. Member checking is considered one of the most important provisions for research credibility and provides verification of a researcher's emerging theories and inferences (Shenton, 2004). It involves presenting the research findings to key informants to determine whether they can recognise their experiences in the findings (Krefting, 1991). Such recognition demonstrates that the research is credible and that the researcher has accurately translated the informants' perspectives of the domain, and decreases the chances of misrepresentation (Krefting, 1991).

3.9 Chapter summary and conclusions

The research methodology, which is a mixed methods research approach, was developed in this chapter. The implementation of the approach involved a qualitative grounded theory method, quantitative content analysis and correspondence analysis, a qualitative focus group method and qualitative member checking. The objectives of this chapter have been fulfilled by establishing the philosophical concepts underpinning the research in subsections 3.2 and 3.3, substantiating the research approach with reference to the research problem, research objective, and research questions in subsections 3.4, 3.5.1, 3.5.2, 3.6.1, 3.6.2, 3.6.3.1, 3.7.1, 3.7.2, and 3.8, and clarifying

the subsequent research methods, especially the aspects of process, sampling, data collection, instrumentation, and data analysis in the correspondingly titled subsections throughout the chapter. Therefore, the chapter's goal of defining and justifying the research methodology has been achieved.

In conclusion, the pragmatist and the dialectical philosophical perspectives or positions allow access to methods based on both positivism and interpretivism through the use of a mixed methods approach. A mixed methods approach has greater applicability to complex organisational research contexts, which applies to this research, and results in a more significant contribution to scholarly and practical knowledge. This approach allows the use of research methods that are particularly well suited to each research sub-objective and research question, being the grounded theory method and content and correspondence analysis for framework development, and the focus group method and member checking for framework verification. Thus, the applicability the research methodology to the research problem, research objective and research questions was demonstrated.

Furthermore, this chapter has value for academics by demonstrating a consistent and appropriate research strategy, philosophical stance, and research approach for IS framework development and verification. This provides a valuable foundation for researchers in terms of future IS framework development. Additionally, this chapter has substantial value for industry and organisations as it provides the detailed reasons for each methodological decision, allowing a decision-maker to develop confidence in and appreciate the usefulness of the research findings.

The next chapter presents the data obtained from the grounded theory method. Chapter Four provides an analysis of the actual data generation process and the data generated, with reference to the principles detailed in Chapter Three.

Chapter 4: Presentation of the Grounded Theory Data

4.1 Chapter introduction

Chapter Four presents the data generated from the grounded theory method, which was justified in Chapter Three. In addition, it provides an analysis both of the actual data generation process and of the data generated, the principles of which were detailed in Chapter Three. The goal of Chapter Four is to expose the implemented grounded theory process as a competent base for the framework development and corroboration in Chapter Five. This goal is achieved through the following chapter objectives: to demonstrate the appropriate sampling procedure, data collection process and instrumentation, and competent data analysis.

Following a detailed account and justification of the grounded theory sampling procedure and data collection process, the chapter exposes the data analysis that developed the categories and category properties through focused codes. Subsequently, the chapter is finalised with a conclusions subsection.

4.2 Theoretical sampling and data collection

The sampling procedure was based on the principles justified in Chapter Three and mandated by the grounded theory method. Initially there was no emergent empirical theory to direct theoretical sampling. Therefore, the first sample was determined by the researcher's general theoretical sensitivity to the research context, which is advocated by grounded theory (Glaser & Strauss, 1967; Corbin & Strauss, 2008; Charmaz, 2006). Thereafter, theoretical sampling occurred together with data collection, coding, and analysis in order to develop the emergent theory. Importantly, none of these activities are isolated, sequential processes (Glaser & Strauss, 1967; Corbin & Strauss, 2008; Charmaz, 2006).

The researcher's theoretical sensitivity directed the researcher to the largest corporate banks in South Africa, because they have the most resources and impact on the environment through their interactions with other organisations in the economy. Corporate banks are those banks that are in the business of financing other organisations throughout the economy; this type of finance is one of their core business offerings. Following this, 100% of the corporate banking organisations in the JSE's top 100 companies list by market capitalisation (Sharenet (Pty) Ltd - Top 100 Companies by Market Capital on 2013/08/21, 2013) were selected. The JSE is South Africa's Johannesburg Stock Exchange and it is the African continent's premier stock exchange (JSE - Johannesburg Stock Exchange, n.d.). There are five such banking organisations in total. Each of the five banking organisations agreed to participate and agreed to be interviewed.

The semi-structured interviews, which involved a few broad open-ended questions allowed the interviewees to reflect on the relevant phenomena. It also allowed the interviewees' stories to emerge and elicited rich data (Charmaz, 2006; Kendall & Kendall, 1993). The interview questions were shaped to obtain rich data while avoiding the imposition of preconceived concepts on the data (Charmaz, 2006).

Indeed, interviews are particularly useful for obtaining insight where interviewees have the relevant strategic and management knowledge (Charmaz, 2006; Allan, 2003). Interviewees that have this knowledge to convey that insight are regarded as key informants (Bhattacherjee, 2012). Therefore, the key informant approach was used, which is an established approach in empirical organisational research (Kim, Shin, & Grover, 2010; Yang, 2005; Nelson & Cooprider, 1996).

In order to locate key informants, the corporate web site of each of the sampled organisations was scrutinised for suitable interviewees. A suitable interviewee was someone in a managerial position that had relevant knowledge and experience relating to environmental sustainability and related organisational IS. Often the names of managers, who are responsible for each organisation's sustainability, are available in the public sustainability reports published on the corporate web site. These managers were contacted telephonically and invited to participate in the research. In some cases, the researcher was referred to another more suitable person in the sustainability or similarly named department who would be available for such an interview. After agreeing to be interviewed during the initial telephone call, and before the actual interview, each interviewee was sent an e-mail, which formally introduced the researcher, explained the research, its objectives, the potential benefits to the interviewee and the interviewee's organisation, and provided the interview guide. In addition, all participants signed the required informed consent form prior to the interviews. Interviews were scheduled for 1 hour. The interviews took place during March and April 2013. All the interviews were electronically recorded, audio only, and subsequently transcribed by the researcher.

Interviews were arranged with the representatives of the five corporate banking organisations in the JSE's top 100 companies; four took place in a meeting room at each of the interviewee's offices, and one took place at a coffee shop of the interviewee's choice. The interviews ranged in duration from 37 minutes to 96 minutes, with an average duration of 65 minutes. In addition, of the five interviewees, three were specialist sustainability management and two were senior sustainability management. After each interview was transcribed, data analysis followed using constant comparison in and across the interviews, data, codes, categories, and their interrelationships. As the conceptual categories, category properties, and their interrelationships began to emerge from the data, it became theoretically relevant to obtain a combined banking industry perspective to elaborate on the differences and similarities within the collected data, and

to further develop the emerging theory. This directed the researcher to an industry body that represents all the registered banks in South Africa.

The interview with the industry body took place in a meeting room at the interviewee's office. The interview duration was 58 minutes, and the interviewee was senior sustainability management. Thereafter, it became evident that the conceptual categories, category properties, and their interrelationships were not fully developed from a purely IT perspective. This directed the researcher to a recognised market leader in South Africa in the domain of sustainable computing and green ICT, with appropriate involvement in the South African banking industry.

The interview with the sustainable computing and green ICT organisation took place at a coffee shop of the interviewee's choice. The interview duration was 44 minutes, and involved two interviewees from the organisation, both directors. The interview provided the necessary elaboration from a purely IT perspective. Following this interview and the subsequent analysis, it was evident that the conceptual categories, category properties, and their interrelationships were now well developed.

Nevertheless, it was deemed appropriate to sample a negative instance, being a purely retail bank. This is regarded as a negative instance because such a bank provides financing to individuals only and not to organisations throughout the economy, while the other sampled banking organisations do. Such sampling ensured that the developed conceptual categories, category properties, and their interrelationships accounted for all instances of the researched phenomena. This directed the researcher to sample a retail banking organisation in the JSE's top 100 companies list by market capitalisation (Sharenet (Pty) Ltd - Top 100 Companies by Market Capital on 2013/08/21, 2013). The interview took place at the interviewee's office. The interview duration was 61 minutes, and the interviewee was specialist sustainability management.

After incorporating the retail bank interview data into the analysis, the already well-developed conceptual categories, category properties, and their interrelationships were not further developed; this indicated that saturation was achieved. In grounded theory, theoretical sampling terminates once theoretical saturation is achieved (Glaser & Strauss, 1967; Corbin & Strauss, 2008; Charmaz, 2006; Orlikowski, 1993). At this point, the conceptual categories, category properties, and their interrelationships provided a coherent and emergent grounded theory. Therefore, no additional interviews were conducted.

Importantly, from the banking industry level in South Africa, 100% of the corporate banking organisations in the JSE's top 100 companies list by market capitalisation were interviewed, or 70% of all the banking organisations, not just corporate banks, in the JSE's top 100 companies list by market capitalisation, or 58% of all the South African registered banking organisations

that are under South African control, not just corporate banks and not just those on the JSE's top 100 companies list by market capitalisation (BASA, n.d.; SARB, 2011). This represents a significant proportion of the South African banking sector and of the influence of the sector on the South African economy and natural environment. In addition, the number of people managing what is termed sustainability in these organisations is very small. Thus, a single key informant from each bank was appropriate. Additionally, all the key informants were specialist management, senior level management, and directors, exhibiting the necessary strategic, management, and operational knowledge.

4.3 Categories, category properties, and focused codes

4.3.1 Environmental sustainability transformation

A core category that emerged from the data is environmental sustainability transformation. Across all interviews codes emerged demonstrating that South African banking organisations are undergoing a process of transformation around environmental sustainability, albeit to varying degrees. The banking organisations are all immersed in this process of transformation internally and also affect this process of transformation in other varied organisations throughout the economy. Such transformations in the banking sector are in response to the many and varied forces on the banks. A few of these forces include exchange listing requirements, regulatory requirements, legislative requirements, Equator Principles, and investor and customer pressures. Detailing these forces is outside the objective of this thesis, given that Green IS did not emerge as one of these forces.

The prevalent response to these forces is a concept of sustainability defined as a combination of economic, environmental, and social performance. Such sustainability subsumes the concept of environmental sustainability as an objective competing against the two other objectives, being social sustainability and economic sustainability. Importantly, economic sustainability appears to have the highest priority. This conceptualisation of sustainability, aided by the theoretical sensitivity to the salient concepts in the literature, denotes a weak form of environmental sustainability. Thus, the concept of weak environmental sustainability transformation emerged as a property of the emergent core category called environmental sustainability transformation. Another property emerged from the data, although to a far lesser degree. Only two focused codes demonstrated this property, which, aided by theoretical sensitivity to the salient concepts in the literature, denotes a strong form of environmental sustainability.

The focused codes that developed the weak environmental sustainability transformation property are: banks are influencing the environmental impacts of their supply chains, banks are applying pressure on the economy to transform, there is conflicting and/or competing social sustainability

and environmental sustainability, economic value is controlling environmental sustainability, employees are still needing to make further behavioural changes, and sustainability is a long, continual, difficult, incremental, uncertain, and progressive transformation. The focused codes of 'there is conflicting and/or competing social sustainability and environmental sustainability' and 'economic value is controlling environmental sustainability' fit the definition of weak environmental sustainability particularly well.

The two focused codes that demonstrated the strong environmental sustainability transformation property are: carbon neutrality achieving strong environmental sustainability at a global level, and facilitating strong environmental sustainability with development of renewable substitutes.

The focused codes are grounded in the data and demonstrate what is happening in the sampled organisations via the key informants. Furthermore, they develop and elaborate the more abstract properties of the core category called environmental sustainability transformation, namely weak environmental sustainability transformation and strong environmental sustainability transformation. The core category of environmental sustainability transformation provides a conceptual handle on the environmental sustainability changes occurring in these organisations, which was highly relevant for the purpose of this research.

4.3.2 Enabling capability of Green IS

Another core category that emerged from the data is the enabling capability of Green IS, which is the intangible characteristic of Green IS that provides the means for environmental sustainability. Importantly, while the literature provided theoretical sensitivity to the salient concept of the enabling as well as transforming capability of Green IS, there was only evidence of the enabling capability of Green IS. Regarding the transforming capability, which is the intangible characteristic of Green IS to drive organisational transformation for environmental sustainability, the evidence shows that there are many and varied forces transforming the banks in terms of environmental sustainability, but Green IS are not one of these forces. Thus, the enabling capability of Green IS provides the means for environmental sustainability both within the banking organisations and in other varied organisations throughout the economy through their interaction with the banks.

Several focused codes developed the enabling capability of Green IS core category through elaborated category properties. Each of these properties is an emergent and salient aspect of the researched domain that is enabled by Green IS, and is a manifestation or evidence of the enabling capability of Green IS. These properties are called business process efficiencies, environmental data management, environmental analysis, environmental information impartment, carbon footprint management, and environmental risk management.

Importantly, business process efficiencies, environmental data management, environmental analysis, and environmental information impartment are considered lower-level properties, while carbon footprint management and environmental risk management are regarded as higher-level properties. This is a relative grouping based on the level of abstraction. Thus, carbon footprint management is more abstract and general than the properties of business process efficiencies, environmental data management, environmental analysis, and environmental information impartment, and in many instances carbon footprint management subsumes these lower-level properties. Similarly, environmental risk management is more abstract and general than the properties of environmental data management, environmental analysis, and environmental information impartment, and in many instances, environmental risk management subsumes these lower-level properties. Nevertheless, these lower-level properties are individual properties, and in other instances are not subsumed by carbon footprint management or environmental risk management.

4.3.2.1 Business process efficiencies

The first property, called business process efficiencies, has uniqueness in comparison to the other properties, but similarity in its environmental sustainability outcome. Its uniqueness is that it relates to IS that are not explicitly designed for environmental sustainability purposes. So it is not explicitly Green IS, but as a consequence of its implementations, the organisation's environmental impact is affected. These IS have the capability to enable environmental sustainability, and are therefore implicitly Green IS. Following this, business process efficiencies are regarded as a property of the enabling capability of Green IS, from the perspective that they are implicitly Green IS. The explicit purpose of the IS that enable business process efficiencies is usually cost reduction, instead of environmental sustainability. Nevertheless, the result is that organisational processes become more efficient resulting in reduced resource usage and/or reduced waste, which translates into improved environmental sustainability. An example is IS-enabled automation of paper-based processes resulting in decreased resource use and waste, and thus an improvement in environmental sustainability.

The focus of this property is the organisation's own internal environmental impact. Furthermore, while this property produces a level of organisational transformation in terms of how the business activities are carried out, which reduces the resource usage and/or reduces waste, the nature of the business activities, including the nature of the business activities' objectives, goals, inputs and outputs, essentially remains unchanged. Thus, this property does not itself transform the fundamental nature of the business activities, but merely makes the same business activities more efficient, and remains a property of the enabling capability of Green IS, although implicit.

The focused codes that develop the first property, called business process efficiencies, are: enabling paper-based processes to be replaced by electronic processes resulting in reduced paper usage, and reducing vehicle fleet travel.

4.3.2.2 Environmental data management

The second property, called environmental data management, involves Green IS that have the capability to enable the management of an organisation's environmental data, such as kilowatt-hours, which are significantly different from an organisation's financial and transactional data. The focus of this property is both the organisation's own internal environmental impact and the environmental impact of interacting external organisations.

The focused codes that develop this property are: Green IS enabling the capture of non-financial data, Green IS enabling the capture of accurate data, Green IS enabling centralised access to geographically dispersed data, Green IS enabling data audit trails and external data verification, Green IS enabling enhanced data capture processes, Green IS enabling the allocation of specific people and/or responsibility for obtaining data, Green IS enabling the management of large volumes of data, and Green IS enabling controlled access to data. Note that the aforementioned references to data refer to environmental data only.

4.3.2.3 Environmental analysis

The third property, called environmental analysis, involves Green IS that enable examination of the effect of business activities on the environment and expose meaningful patterns, for example environmental dashboards. The focus of this property is both the organisation's own internal environmental impact and the environmental impact of interacting external organisations. The focused codes that develop this property are: Green IS enabling environmental analysis for uncovering trends and reduction opportunities, Green IS enabling comparisons year to year or to a baseline year, Green IS enabling future projections, Green IS enabling slicing and dicing analysis, and Green IS enabling visual analysis through charts and graphs.

4.3.2.4 Environmental information impartment

The fourth property, called environmental information impartment, involves Green IS that have the capability to enable the impartment of an organisation's environmental information. The focus of this property is both the organisation's own internal environmental impact and the environmental impact of interacting external organisations. These Green IS enable environmental information to be imparted appropriately, for example with specifically designed reports or even product carbon footprint details on mobile phones, to each type of stakeholder, for example management, clients, investors, or government.

The focused codes that develop this property are: Green IS enabling environmental information to be made relevant and meaningful for each audience, Green IS enabling an informed environmental strategy, Green IS enabling environmental awareness right up to top management, Green IS enabling public disclosure, and Green IS enabling sustainability reporting.

4.3.2.5 Carbon footprint management

The fifth property, called carbon footprint management, involves Green IS that enable the management of an organisation's GHG emissions. The focus of this property is the organisation's own internal environmental impact. The focused codes that develop this property are: Green IS enabling carbon performance management, Green IS enabling electricity usage management, and Green IS enabling enterprise carbon accounting.

4.3.2.6 Environmental risk management

The sixth property, called environmental risk management, involves Green IS that have the capability to enable the management of risks to a banking organisation arising from the environmental impacts of financing. The focus of this property is the environmental impact of interacting external organisations. For example, credit risk due to the inability of borrowers to repay loans as a result of environmental damage stopping production, excessive fines, environmental taxation, or legislation, and reputational risk that impacts share price and investment. The focused codes that develop this property are: Green IS enabling environmental and social impact assessments, Green IS enabling the prevention of environmental risk management circumvention, and Green IS enabling complexity in projects to be handled.

4.3.3 Moderating concepts

In addition, three pertinent concepts emerged from the data that moderate the indicated relationship between the enabling capability of Green IS core category and the environmental sustainability transformation core category. These concepts have a contingent effect on the relationship, which means that the relationship is dependent on and affected by the existence of these moderating concepts. These moderating concepts are aspects that determine how the enabling capability of Green IS affects environmental sustainability transformation. The data indicates that if there is a good (poor) level of each moderating concept with regard to the enabling capability of Green IS, then there is a resultant improvement (deterioration) in the level of environmental sustainability transformation.

4.3.3.1 Green IS integration

The first moderating concept is called Green IS integration. The data demonstrates that a lack of integration of Green IS into organisational systems and processes facilitates the exclusion of

environmental considerations, which negatively affects environmental sustainability. Furthermore, where Green IS are integrated, environmental diligence cannot be circumvented, which promotes environmental sustainability.

The focused codes that develop the first moderating concept are: integrating carbon accounting into investment decision-making, integrating financial and non-financial data in risk management systems and processes, integrating Green IS into existing systems and processes for sustainability, and integrating non-financial data and financial data in reporting.

4.3.3.2 Environmental data quality

The second moderating concept is called environmental data quality. Environmental data is significantly different from the financial and transactional data historically managed by banking organisations, and its quality has a substantial effect on any environmental sustainability transformation. This concept emerged as highly important and one that is a particularly difficult aspect in this domain. The research data showed that poor environmental data quality hinders environmental management, produces inaccurate environmental reporting, baselines and targets, and results in poor environmental decision-making and ineffective subsequent environmental performance.

The focused codes that develop the second moderating concept are: accurate data being a prerequisite for sustainability management and decision-making, balancing environmental data accuracy against cost, effort, and time, developing access to the many internal and external people in control of environmental data a prerequisite for gathering data, Green IS data component being vital for Green IS effectiveness, and having great difficulties gathering environmental data.

4.3.3.3 Environmental-financial translation

The third moderating concept is called environmental-financial translation. The data shows that environmental sustainability is managed and controlled by measuring its financial or economic value. Without environmental-financial translation, sustainability cannot be managed or controlled and this has a material effect on any environmental sustainability transformation. In particular, top management and decision committees require monetary values together with non-monetary quantitative and qualitative information in order to make decisions; this is to ensure that there are sufficient financial resources to implement any changes.

The focused codes that develop the third moderating concept are: sustainability being controlled and managed by measuring financial or economic value, carbon neutrality linking financial or economic value to sustainability, difficulty measuring the financial or economic value of sustainability, Green IS enabling the management of financial or economic values related to

sustainability, having to account for externalities as financial costs, linking environmental activity to available financial information facilitates environmental estimations, and requiring formalised rules for the financial effect of environmental impacts on financing.

4.4 Chapter summary and conclusions

Chapter Four detailed the data generated from the grounded theory method. Furthermore, it provided an analysis of the actual data generation process and an analysis of the data generated. All the chapter objectives have been met: the appropriate sampling procedure was demonstrated in subsection 4.2, which also contained an explanation of the appropriate data collection process and instrumentation. Competent data analysis was described in subsection 4.3. Thus, the goal of Chapter Four has been achieved, which was to expose the implemented grounded theory process as a competent base for the framework development and corroboration in Chapter Five.

In conclusion, the grounded theory method provided clear and well-established procedures in terms of sampling, instrumentation, data collection, and data analysis, to enable the researcher to embark on addressing the second research question. The grounded theory method implementation in this chapter demonstrated the emergence of original theory that was intimately linked to the data, allowing the researcher to confidently develop the essential building blocks of the IS framework. These essential building blocks are the emergent conceptual categories, category properties, and their interrelationships.

This chapter has value for academics by revealing how applicable and rigorous the grounded theory method is for framework development, especially when there is no existing theory to address the research problem, and when the research problem involves complex organisational contexts and organisational transformation. Additionally, this chapter has substantial value for industry and organisations as it establishes the necessary relevance through its intimacy with the data. In addition, the chapter's thick or detailed descriptions provide the basis for practitioners to develop confidence in the usefulness of the resulting findings.

Chapter Five is based on Chapter Four's presentation of the grounded theory data. Chapter Four's presentation of the grounded theory data is the basis for the framework development and corroboration in Chapter Five. This is achieved through quantitative content and correspondence analysis.

Chapter 5: Framework Development and Corroboration

5.1 Chapter introduction

The presentation of the grounded theory data in Chapter Four formed the basis for the development of the framework in this chapter. Chapter Five completes the framework development with corroboration involving quantitative content and correspondence analysis. The goal of the chapter is to answer the second research question: how do the enabling and transforming capabilities of Green IS manifest and relate to environmental sustainability?

This goal is achieved through the following chapter objectives: expose the emergent interrelationships between the conceptual categories and category properties, depict the framework as a set of conceptual categories, category properties, and their interrelationships, and corroborate the framework through quantitative content and correspondence analysis.

Subsection 5.2, which follows this introduction, exposes the emergent relationships between the grounded theory conceptual categories and category properties and culminates in a depiction of the framework. Thereafter, the results of the quantitative content and correspondence analysis are presented. Conclusions are then drawn and presented in subsection 5.5.

5.2 Framework categories, properties, and their interrelationships

5.2.1 Environmental sustainability transformation

Following from Chapter Four, a core category that emerged from the data is environmental sustainability transformation. It is evident from the data that two main types of environmental sustainability transformation are prevalent, namely the concept of weak environmental sustainability transformation and that of strong environmental sustainability transformation. Both of these concepts are properties of the core category environmental sustainability transformation.

5.2.2 Enabling capability of Green IS

Following from Chapter Four, a core category that emerged from the data is the enabling capability of Green IS, which is the intangible characteristic of Green IS that provides the means for environmental sustainability. This indicates a causal relationship between the enabling capability of Green IS core category and the environmental sustainability transformation core category. In this relationship, the enabling capability of Green IS core category is considered the independent variable and the environmental sustainability transformation core category the dependent variable.

Within the enabling capability of Green IS core category, there are six category properties. Each property is an emergent and salient aspect of the researched domain that is enabled by Green IS,

and is a manifestation or evidence of the enabling capability of Green IS. In other words, the enabling capability of Green IS manifests or is evident in six Green IS enabled management functions. These properties are called business process efficiencies, environmental data management, environmental analysis, environmental information impartment, carbon footprint management, and environmental risk management.

As established in Chapter Four, carbon footprint management is more abstract and general than the properties of business process efficiencies, environmental data management, environmental analysis, and environmental information impartment, and in many instances carbon footprint management subsumes these lower-level properties. Similarly, environmental risk management is more abstract and general than the properties of environmental data management, environmental analysis, and environmental information impartment, and in many instances, environmental risk management subsumes these lower-level properties. Nevertheless, these lower-level properties are individual properties, and in other instances are not subsumed by carbon footprint management or environmental risk management.

Notably, where business process efficiencies are implicit in nature, in other words where this property is not explicitly designed for environmental sustainability purposes, but as a consequence of its implementations the organisation's environmental impact is affected, there is a direct relationship of this property to environmental sustainability transformation. This direct relationship circumvents the moderating concepts and illustrates the unintentional environmental sustainability benefits of those IS-enabled business process efficiencies that are primarily intended to reduce costs. The framework also includes those IS-enabled business process efficiencies that are primarily intended to improve environmental sustainability, which are then affected by the moderating concepts.

5.2.3 Moderating concepts

Following from Chapter Four, three pertinent concepts emerged from the data that moderate the relationship between the enabling capability of Green IS core category and the environmental sustainability transformation core category. These concepts have a contingent effect on the relationship, which means that the relationships are dependent on and affected by the existence of these moderating concepts. These moderating concepts are aspects that determine how the enabling capability of Green IS affects environmental sustainability transformation. The data indicates that if there is a good (poor) level of the moderating concepts with regard to the enabling capability of Green IS, then there is a resultant improvement (deterioration) in the level of environmental sustainability transformation. These concepts are Green IS integration, environmental data quality, and environmental-financial translation. Green IS integration relates

to the level of integration of Green IS into the current organisational systems and processes. Environmental data quality relates to the level of environmental data quality. Environmental-financial translation relates to the level of assignment of economic value or monetary values to the organisation's environmental interactions.

5.2.4 The Green IS framework

The enabling capability of Green IS core category and its properties, the environmental sustainability transformation core category and its properties, the moderating concepts, and the corresponding aforementioned interrelationships form the Green IS framework, which is depicted in Figure 5 below.

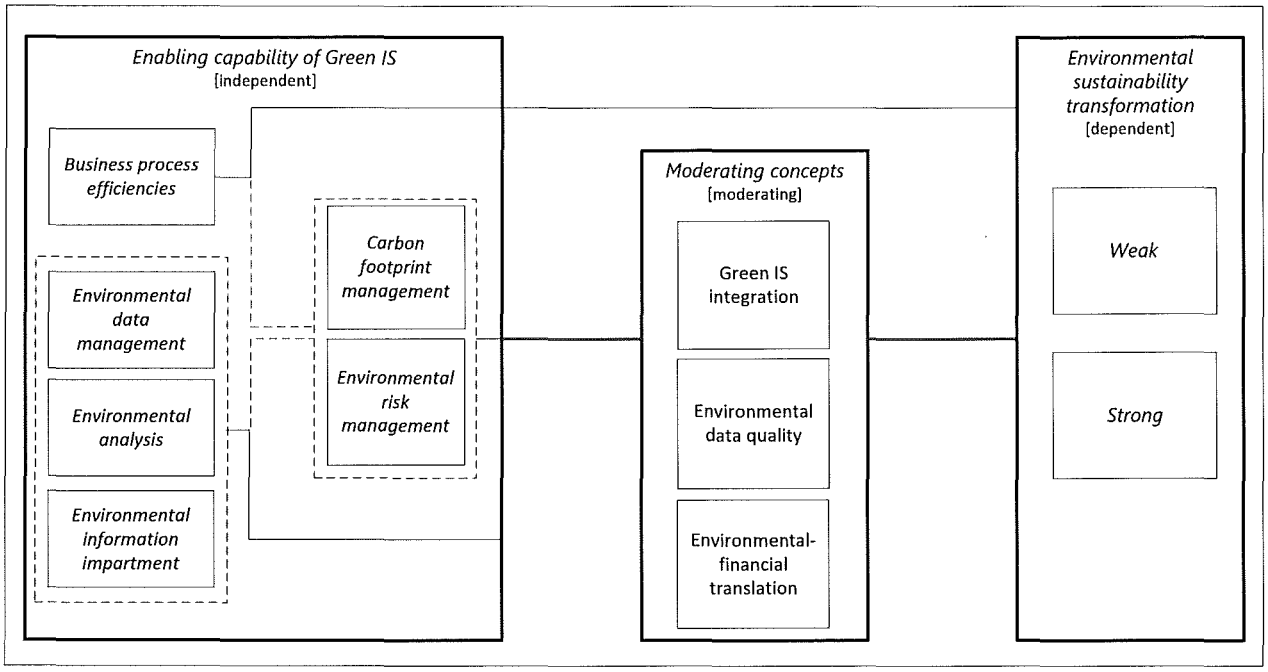

Figure 5: The Green IS framework

Following the development of the framework, depicted in Figure 5 above, quantitative content analysis and correspondence analysis were performed to corroborate the developed framework. These analyses were justified and explained in Chapter Three. Essentially, the combination of qualitative and quantitative methods of data collection and analysis provides triangulation, strengthens the research findings, improves the accuracy of inferences, and increases credibility.

5.3 Content analysis

5.3.1 Context units

Content analysis investigates the intensity of context units contained in the interview transcripts (Remenyi, 1992). It can be performed on various types of context units, such as specific words, sentences, characters, or concepts (Ceci & Iubatti, 2012). The context unit in this research was

the concept, being the concepts that emerged during the grounded theory analysis, and in this regard, content analysis can be considered subjective. However, given the strength of grounded theory for developing theory and its interpretivistic philosophy, the grounded theory concepts provided the appropriate points of departure (Bryman & Bell, 2011). Indeed, these concepts were the concepts of interest to the research. Thus, the 208 pages of typed interview transcripts produced during the grounded theory phase were content analysed in terms of the grounded theory concepts (Bhattacherjee & Premkumar, 2004).

Specifically, the concepts of interest were the environmental sustainability transformation core category properties, namely weak environmental sustainability transformation (WEST) and strong environmental sustainability transformation (SEST); the enabling capability of Green IS core category properties, namely Green IS enabled business process efficiencies (GIEBPE), Green IS enabled environmental data management (GIEEDM), Green IS enabled environmental analysis (GIEEABA), Green IS enabled environmental information impartment (GIEEII), Green IS enabled carbon footprint management (GIECFM), and Green IS enabled environmental risk management (GIEERM); and the moderating concepts of Green IS integration (GII), environmental data quality (EDQ), and environmental-financial translation (EFT). It is important to note that the wording of the enabling capability of Green IS core category properties was altered slightly from "enabling" to "enabled", because the coding method followed during the grounded theory phase necessitated using gerunds. However, the wording "enabled" is more appropriate for the content analysis and it does not change the conceptual meanings.

Following the context unit determination was the development of the coding dictionary (Ceci & Iubatti, 2012). Thereafter, each interview transcript was scrutinised based on the coding dictionary, and the number of times each concept was mentioned in each transcript was recorded. This count provided a measure of concept importance (Bryman & Bell, 2011). The result of the content analysis is a concept-count matrix or concept contingency table showing a multivariate frequency distribution, which facilitated the comparison of the concepts and the identification of patterns.

5.3.2 Coding dictionary

The content analysis process began with the development of a coding dictionary, which is a set of rules to ensure consistent and correct identification of each concept to be counted in the transcripts (Bryman & Bell, 2011). The purpose of a coding dictionary is to provide guidance and ensure consistency, reliability, transparency, replicability, and objectivity. Table 2 below shows the coding dictionary used.

No.	Research Concepts
1.	Weak environmental sustainability transformation (WEST) Concept identification Weak environmental sustainability is termed ecological modernisation and involves the practice of combining the contradictory principles of economic growth and throughput-based sustainability (Milne *et al.*, 2006). Implementations of weak environmental sustainability promote sustained capitalism and business at the expense of the environment (Laine, 2010). This is a flexible type of environmental sustainability that accommodates current economic practices (Manzini *et al.*, 2011; Jenkin *et al.*, 2011).
2.	Strong environmental sustainability transformation (SEST) Concept identification The fundamental principles of strong environmental sustainability state that the depletion rate of non-renewables must be within the development rate for renewable substitutes (Goodland & Daly, 1996), the consumption rate of renewable resources must be within the environmental regeneration rates, and waste emission rates must be within the environmental assimilation rates (Manzini *et al.*, 2011).
3.	Green IS enabled business process efficiencies (GIEBPE) Concept identification IS-enabled business process efficiencies where an outcome is a form of environmental sustainability.
4.	Green IS enabled environmental data management (GIEEDM) Concept identification Green IS that enable the management of an organisation's environmental data.
5.	Green IS enabled environmental analysis (GIEEABA) Concept identification Green IS that enable examination of the effect of business activities on the environment and expose meaningful patterns.
6.	Green IS enabled environmental information impartment (GIEEII) Concept identification Green IS that enable the impartment of an organisation's environmental information.
7.	Green IS enabled carbon footprint management (GIECFM) Concept identification Green IS that enable the management of an organisation's GHG emissions.
8.	Green IS enabled environmental risk management (GIEERM) Concept identification Green IS that enable the management of risks to the organisation arising from the environmental impacts of financing activities.
9.	Green IS integration (GII) Concept identification Green IS integration or the lack thereof into organisational systems and processes where this ultimately affects environmental sustainability, positively or negatively. It indicates that Green IS integration is an essential part of how Green IS affect environmental sustainability.
10.	Environmental data quality (EDQ) Concept identification Environmental data quality or the lack thereof, relating to Green IS, where this ultimately affects environmental sustainability, positively or negatively. It indicates that Green IS environmental data quality is an essential part of how Green IS affect environmental sustainability.

No.	Research Concepts
11.	Environmental-financial translation (EFT) Concept identification Relating to Green IS, environmental-financial translation is assigning economic value to environmental interactions, or the lack thereof, where this ultimately affects environmental sustainability, positively or negatively. It indicates that environmental-financial translation within Green IS is an essential part of how Green IS affect environmental sustainability.

Table 2: The coding dictionary

5.3.3 Results

The concept-count matrix or concept contingency table produced by the content analysis is shown in Table 3 below.

Organisation / Concept	Corp Bank A (CA)	Corp Bank B (CB)	Corp Bank C (CC)	Ind Body (IA)	Soft Vend (SV)	Retail Bank (RB)	Corp Bank D (CD)	Corp Bank E (CE)	Total
Weak environmental sustainability transformation (WEST)	19	19	13	33	31	35	32	53	235
Strong environmental sustainability transformation (SEST)	1	0	0	0	0	0	0	1	2
Green IS enabled business process efficiencies (GIEBPE)	3	1	0	0	0	17	0	0	21
Green IS enabled environmental data management (GIEEDM)	18	16	0	0	3	20	7	13	77
Green IS enabled environmental analysis (GIEEABA)	5	2	0	1	1	7	1	2	19
Green IS enabled environmental information impartment (GIEEII)	19	9	6	4	13	5	0	6	62
Green IS enabled carbon footprint management (GIECFM)	8	12	2	1	18	20	3	9	73
Green IS enabled environmental risk management (GIEERM)	9	7	0	1	10	0	20	4	51
Green IS integration (GII)	12	7	1	2	4	6	20	5	57
Environmental data quality (EDQ)	34	8	16	3	7	42	32	82	224
Environmental-financial translation (EFT)	9	1	4	2	3	13	3	12	47
Total	137	82	42	47	90	165	118	187	868

Table 3: Concept contingency table

The content analysis concept contingency table data was input into the statistical software application called SPSS (IBM SPSS, n.d.), and descriptive statistical analyses were performed. These analyses were based on bar charts showing relative frequencies of each concept, which is a measure of concept importance. The first bar chart, Figure 6 below, shows the total frequency of each concept across all organisations, in ascending order.

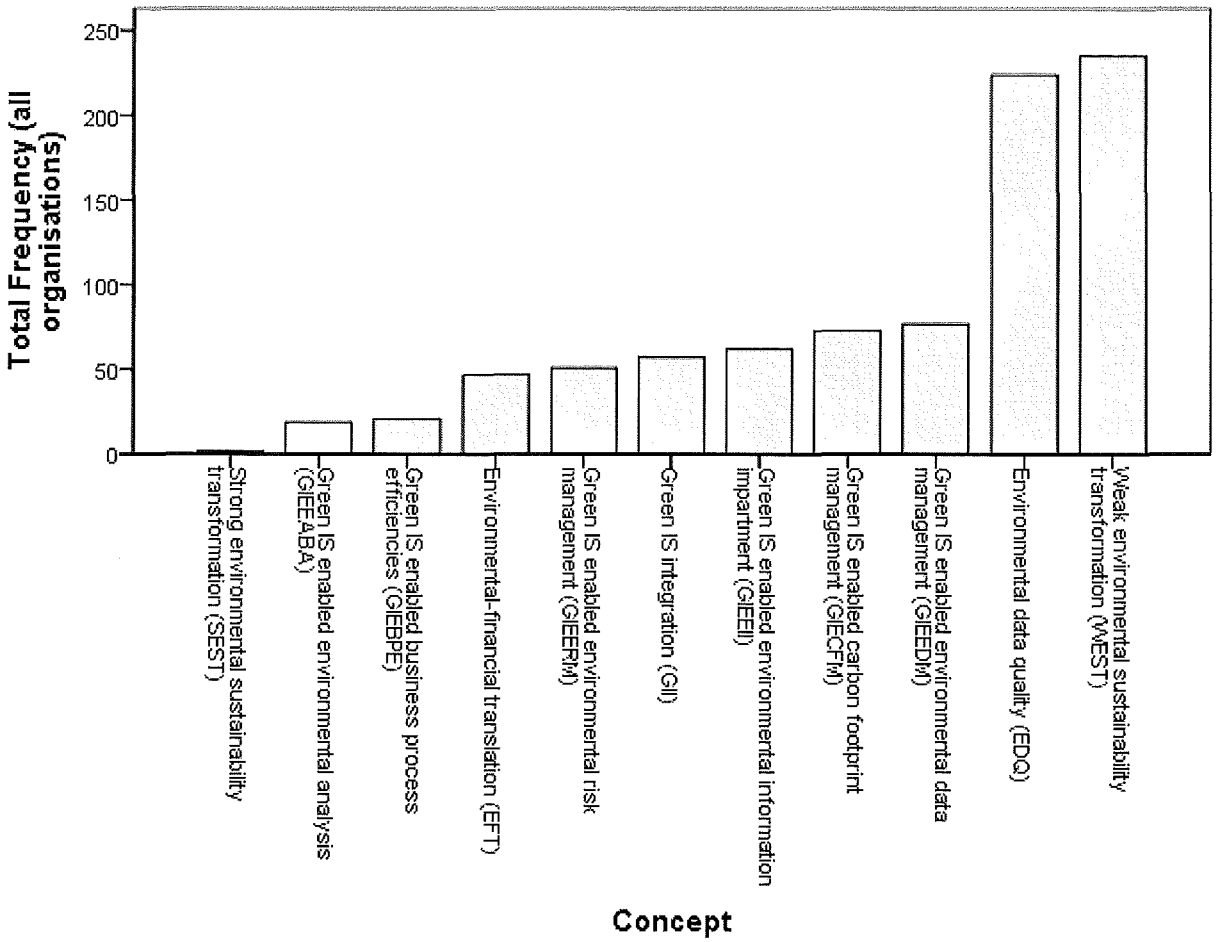

Figure 6: Total frequency per concept across all organisations

With regard to environmental sustainability transformation, Figure 6 above illustrates the prevalence of weak environmental sustainability transformation (WEST) and the lack of strong environmental sustainability transformation (SEST). The bar chart also illustrates the concepts relating to the enabling capability of Green IS core category. The Green IS enabled business process efficiencies (GIEBPE) and Green IS enabled environmental analysis (GIEEABA) feature less than half the frequency of the other four concepts relating to the enabling capability of Green IS core category properties. This illustrates that these organisations focused comparatively similar and more attention on Green IS enabled environmental data management (GIEEDM), Green IS enabled environmental information impartment (GIEEII), Green IS enabled carbon footprint management (GIECFM), and Green IS enabled environmental risk management (GIEERM). In addition, the bar chart shows that there is slightly more focus on internal environmental sustainability, namely Green IS enabled carbon footprint management (GIECFM), than external environmental sustainability, namely Green IS enabled environmental risk management (GIEERM).

The moderating concepts of Green IS integration (GII), environmental data quality (EDQ), and environmental-financial translation (EFT) all show importance when compared with the

concepts relating to the enabling capability of Green IS core category. However, the moderating concept of environmental data quality (EDQ) shows great importance, which also provides an explanation for the relatively high focus on the enabling capability of Green IS core category concept called Green IS enabled environmental data management (GIEEDM). The second bar chart, Figure 7 below, shows the frequency of each concept by organisation.

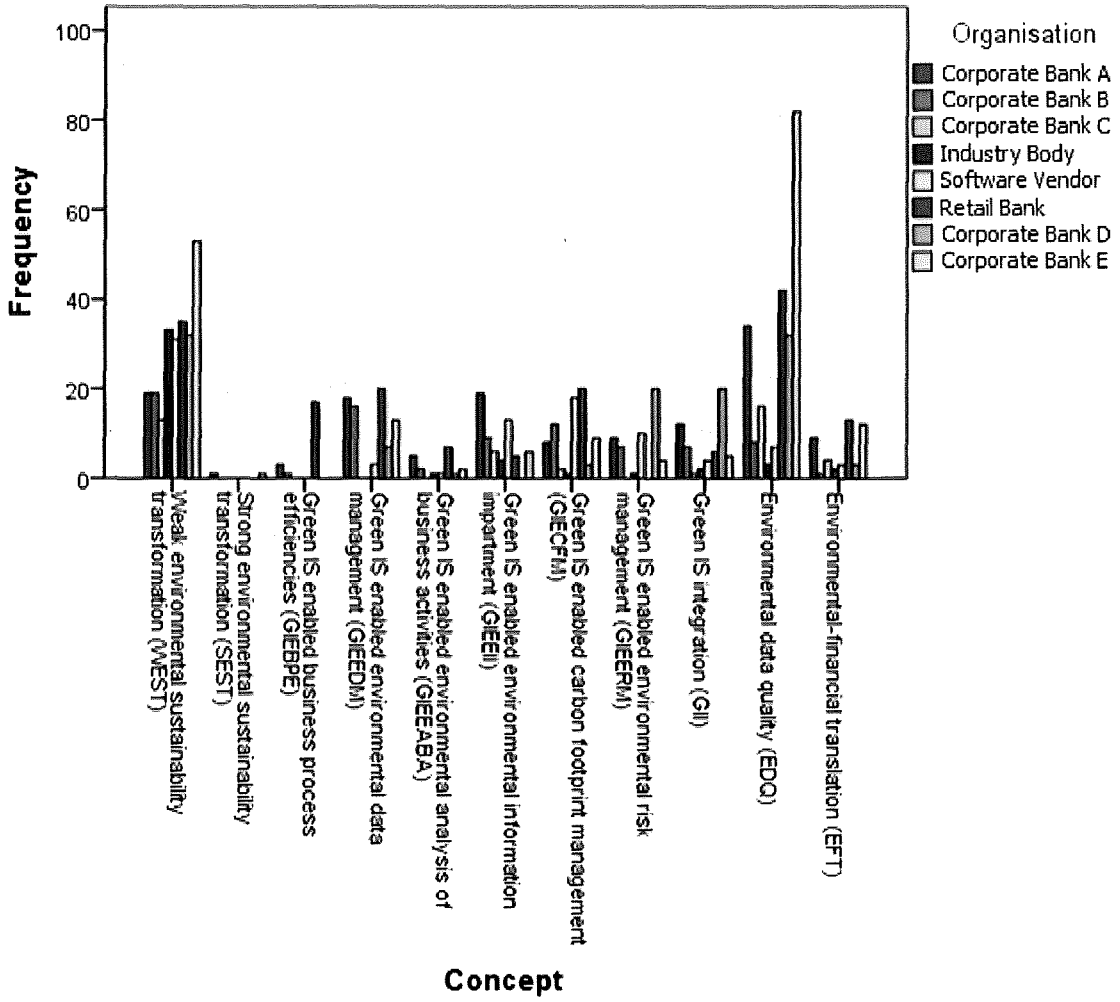

Figure 7: Frequency of each concept by organisation

Figure 7 above illustrates the relative importance each organisation placed on each concept. The environmental sustainability transformation core category concepts both show a comparatively similar focus within each concept across the organisations. However, some of the concepts relating to the enabling capability of Green IS core category properties show great differences. In particular, the retail bank focused largely on Green IS enabled business process efficiencies (GIEBPE), which indicated that they have many opportunities to automate paper-based processes.

Furthermore, the industry body and software vendor were not focused specifically on Green IS enabled environmental data management (GIEEDM), and this is explained by them not having

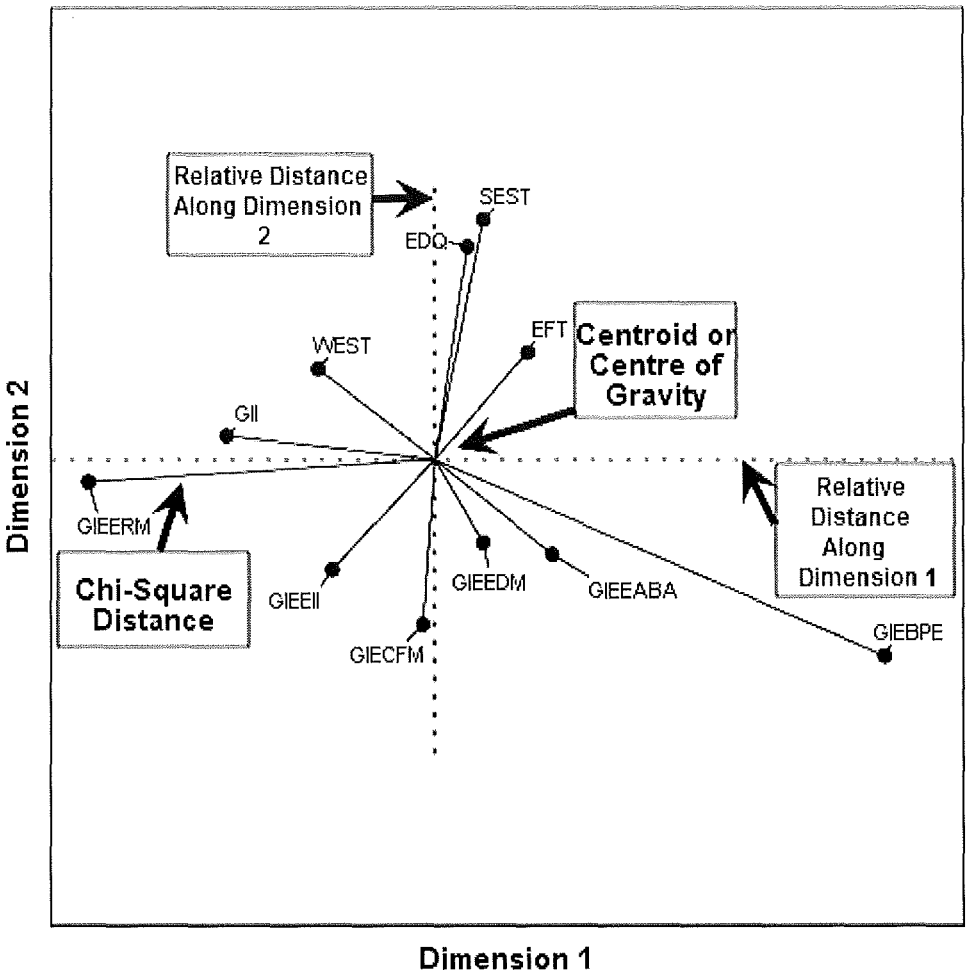

Figure 8: Correspondence analysis perceptual map description

5.4.2 Assessment of perceptual map dimensions

Before analysing the perceptual map, there were a number of important outputs to consider first, and these outputs relate to the selected number of dimensions of the perceptual map and the related inertias.

Dimension	Proportion of Inertia	
	Accounted for	Cumulative
1	.321	.321
2	.264	.584
3	.206	.790
4	.119	.910
5	.051	.960
6	.035	.995
7	.005	1.000
Total	1.000	1.000

Table 4: Total inertia per dimension

Table 4 above shows how the total inertia is decomposed along the maximum number of dimensions based on the contingency table data. The first dimension accounted for 32.1% of the total inertia and the second dimension for another 26.4% of the total inertia. Therefore, displaying two dimensions accounted for 58.4% of the total inertia or almost two-thirds, and yielded useful analysis. Therefore, the analysis proceeded with a two-dimensional perceptual map.

Overview Row Points

Concept	Mass	Contribution				
		Of Point to Inertia of Dimension		Of Dimension to Inertia of Point		
		1	2	1	2	Total
WEST	.271	.078	.026	.190	.052	.242
SEST	.002	.001	.005	.033	.127	.160
GIEBPE	.024	.314	.086	.641	.144	.786
GIEEDM	.089	.039	.092	.155	.299	.454
GIEEABA	.022	.030	.027	.418	.309	.726
GIEEII	.071	.014	.107	.041	.269	.310
GIECFM	.084	.004	.227	.015	.641	.656
GIEERM	.059	.292	.018	.685	.035	.720
GII	.066	.097	.003	.369	.008	.377
EDQ	.258	.078	.399	.165	.696	.862
EFT	.054	.053	.010	.645	.103	.748
Active Total	1.000	1.000	1.000			

Table 5: Contributions per concept to inertia of first two dimensions and vice versa

Furthermore, Table 5 above shows how each concept contributed to the inertia of the first two dimensions and how the first two dimensions contributed to the inertia of each concept. It is the concepts Green IS enabled business process efficiencies (GIEBPE) and Green IS enabled environmental risk management (GIEERM) that contributed the most to dimension 1, while strong environmental sustainability transformation (SEST) and Green IS enabled carbon

footprint management (GIECFM) contributed the least to dimension 1. In addition, it is the concepts Green IS enabled carbon footprint management (GIECFM) and environmental data quality (EDQ) that contributed the most to dimension 2, while strong environmental sustainability transformation (SEST) and Green IS integration (GII) contributed the least to dimension 2. Notably, if all concepts contributed equally to the inertia of each dimension then each contribution would be 0.091. It is evident that only strong environmental sustainability transformation (SEST) contributed very little to both dimensions. However, it contributed greatly to dimension 7, but considering seven dimensions simultaneously is extremely difficult to display and interpret. Given the lack of strong environmental sustainability transformation (SEST) in the data, the effect of its small contribution to both dimensions was considered negligible in terms of the overall corroboration.

When considering how the first two dimensions contributed to the inertia of each concept, it is evident that the total contribution of the first two dimensions was good for the concepts Green IS enabled business process efficiencies (GIEBPE), Green IS enabled environmental analysis (GIEEABA), Green IS enabled carbon footprint management (GIECFM), Green IS enabled environmental risk management (GIEERM), environmental data quality (EDQ), and environmental-financial translation (EFT). It was adequate for the concepts weak environmental sustainability transformation (WEST), Green IS enabled environmental data management (GIEEDM), Green IS enabled environmental information impartment (GIEEII), and Green IS integration (GII), and it was poor for strong environmental sustainability transformation (SEST). Again, higher dimensions contributed better to strong environmental sustainability transformation (SEST), but this effect was considered negligible in terms of the overall corroboration, given the lack of strong environmental sustainability transformation (SEST) in the data. Notably, the total contribution across all seven dimensions per concept adds up to 1. Therefore, Table 5 above illustrates that the concepts were suitably represented in the first two dimensions, which supported proceeding with a two-dimensional perceptual map.

Overview Column Points

Organisation	Mass	Contribution				
		Of Point to Inertia of Dimension		Of Dimension to Inertia of Point		
		1	2	1	2	Total
CA	.158	.002	.031	.009	.111	.120
CB	.094	.020	.214	.077	.669	.745
CC	.048	.001	.057	.008	.308	.316
IA	.054	.070	.009	.160	.017	.177
SV	.104	.125	.161	.305	.322	.627
RB	.190	.488	.066	.775	.086	.861
CD	.136	.265	.048	.460	.068	.528
CE	.215	.029	.414	.068	.810	.878
Active Total	1.000	1.000	1.000			

Table 6: Contributions per organisation to inertia of first two dimensions and vice versa

Similarly, Table 6 above shows how each organisation contributed to the inertia of the first two dimensions and how the first two dimensions contributed to the inertia of each organisation. It is the retail bank and corporate bank D that contributed the most to dimension 1, while corporate banks A and C contributed the least to dimension 1. In addition, it is corporate banks B and E that contributed the most to dimension 2, while the industry body contributed the least to dimension 2. Notably, if all concepts contributed equally to the inertia of each dimension, then each contribution would be 0.125. It is evident that none of the organisations contributed very little to both dimensions.

When considering how the first two dimensions contributed to the inertia of each organisation, it is evident that the total contribution of the first two dimensions was good for corporate banks B, D, and E, the software vendor, and the retail bank; adequate for corporate bank C; and poor for corporate bank A and the industry body. Higher dimensions contributed better to corporate bank A and the industry body, but since the primary focus of the analysis was the concept associations and not the organisation associations, this effect was not considered detrimental to the analysis. Notably, the total contribution across all seven dimensions per organisation adds up to 1. Therefore, Table 6 above illustrates that the organisations were suitably represented in the first two dimensions, which supported proceeding with a two-dimensional perceptual map.

5.4.3 Results

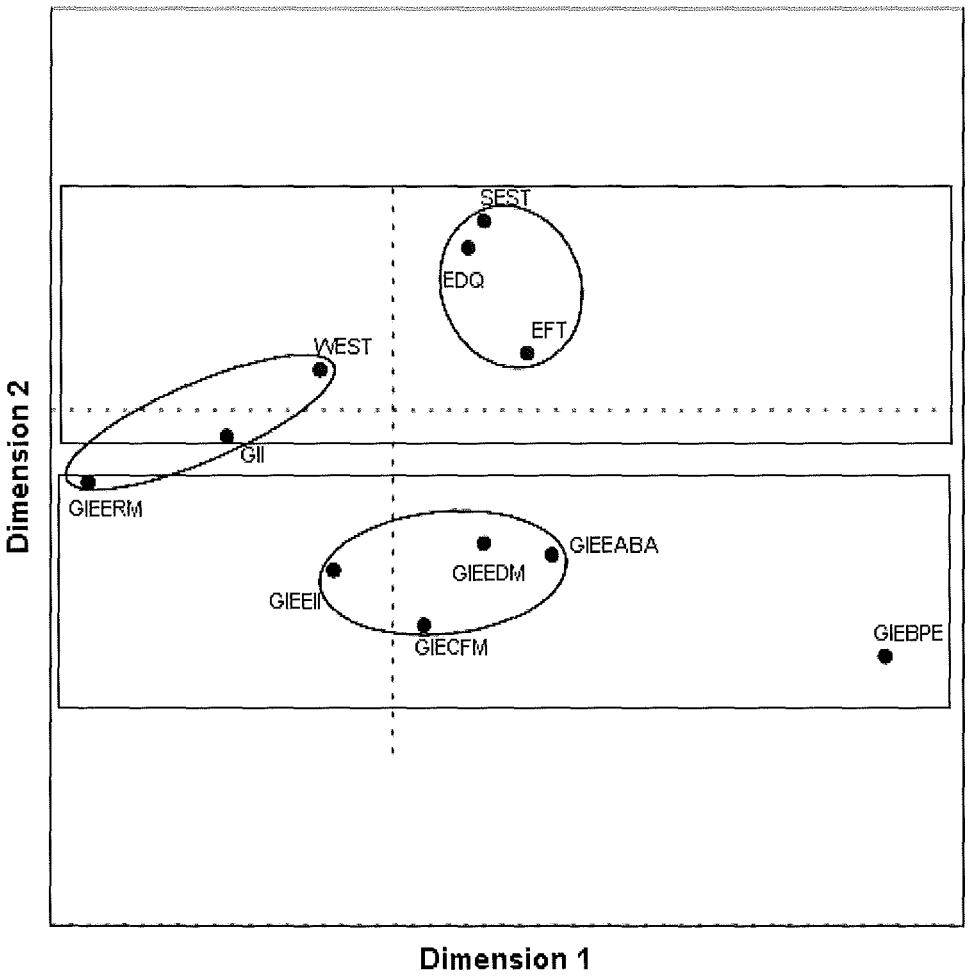

Figure 9: Concept perceptual map

Figure 9 above presents the two-dimensional perceptual map for the concepts. The map shows a general vertical axis split, where the top rectangle grouping incorporates the concepts weak environmental sustainability transformation (WEST), strong environmental sustainability transformation (SEST), Green IS integration (GII), environmental data quality (EDQ), and environmental-financial translation (EFT). These are the framework concepts relating to the environmental sustainability transformation core category and the variables that moderate the relationship between the enabling capability of Green IS core category and environmental sustainability transformation core category. It suggests that these moderating concepts are associated with environmental sustainability transformation.

The bottom rectangle grouping incorporates the concepts Green IS enabled environmental risk management (GIEERM), Green IS enabled environmental information impartment (GIEEII), Green IS enabled environmental data management (GIEEDM), Green IS enabled environmental analysis (GIEEABA), Green IS enabled carbon footprint management (GIECFM), and Green IS enabled business process efficiencies (GIEBPE). These are the framework concepts relating to

the Green IS enabling capability core category and suggests that there is a Green IS enabling capability core category association among them. Notably, Green IS enabled business process efficiencies (GIEBPE) is away from all the other concepts to the right, which supports its unique and implicit Green IS relation. In addition, Green IS enabled environmental risk management (GIEERM) is away from all the other concepts to the left, supporting its unique external focus compared to the other Green IS enabling capability core category concepts. Furthermore, the extreme horizontal split between Green IS enabled environmental risk management (GIEERM) and Green IS enabled business process efficiencies (GIEBPE) illustrates the uniqueness and dissimilarity between these concepts, being externally and environmental sustainability focused and internally and cost efficiency focused, respectively.

In addition, there are a number of closely grouped clusters. Strong environmental sustainability transformation (SEST), environmental data quality (EDQ), and environmental-financial translation (EFT) are one such cluster, suggesting that environmental data quality (EDQ) and environmental-financial translation (EFT) are particularly associated with strong environmental sustainability transformation (SEST).

Another cluster is Green IS enabled environmental risk management (GIEERM), Green IS integration (GII), and weak environmental sustainability transformation (WEST), which suggests that the current form of environmental sustainability transformation, namely weak environmental sustainability transformation (WEST), is associated with Green IS enabled environmental risk management (GIEERM) and moderated by Green IS integration (GII). This provides support that Green IS integration (GII) is necessary to leverage Green IS enabled environmental risk management (GIEERM) for weak environmental sustainability transformation (WEST).

The third cluster is Green IS enabled environmental information impartment (GIEEII), Green IS enabled environmental data management (GIEEDM), Green IS enabled environmental analysis (GIEEABA), and Green IS enabled carbon footprint management (GIECFM), supporting the framework where Green IS enabled carbon footprint management (GIECFM) is closely associated with, and in many cases subsumes, Green IS enabled environmental information impartment (GIEEII), Green IS enabled environmental data management (GIEEDM), and Green IS enabled environmental analysis of business activities (GIEEABA).

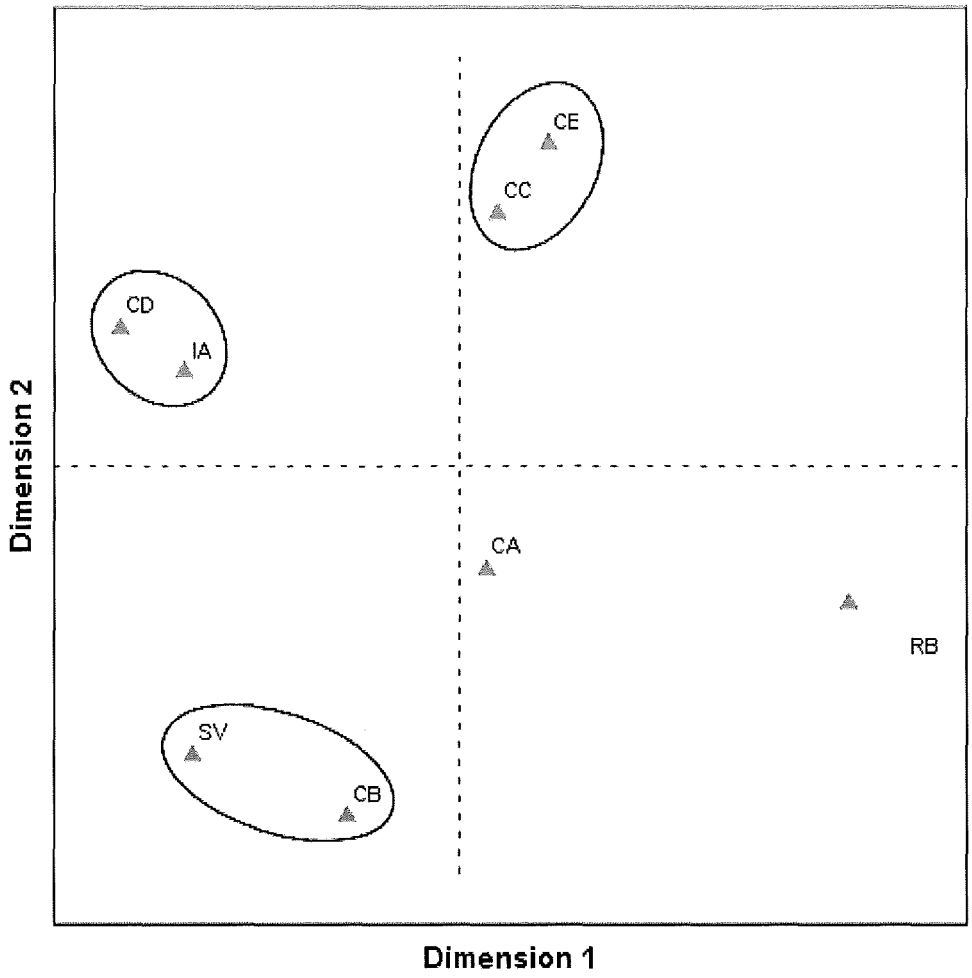

Figure 10: Organisation perceptual map

Figure 10 above presents the two-dimensional perceptual map for the organisations. The map shows that the organisations are widely spread, indicating that they had unique characteristics, even though many were in the same banking industry. This supports the adequacy of the sample by showing that the data accounts for wide variety across the industry. Nevertheless, there are a number of closely grouped clusters. These clusters are corporate bank D and the industry body; corporate banks E and C; and the software vendor and corporate bank B. The clustered organisations indicate commonality between these organisations. It is apparent that the industry body had comparable views to one of the corporate banks, as did the software vendor; this provides support that these non-corporate banking organisations understood the corporate banking aspects relating to the research and were relevant to the research. The retail bank stands out on its own away from the other organisations, which supports its role as a negative sampling instance, because such a bank does not provide financing to organisations throughout the economy.

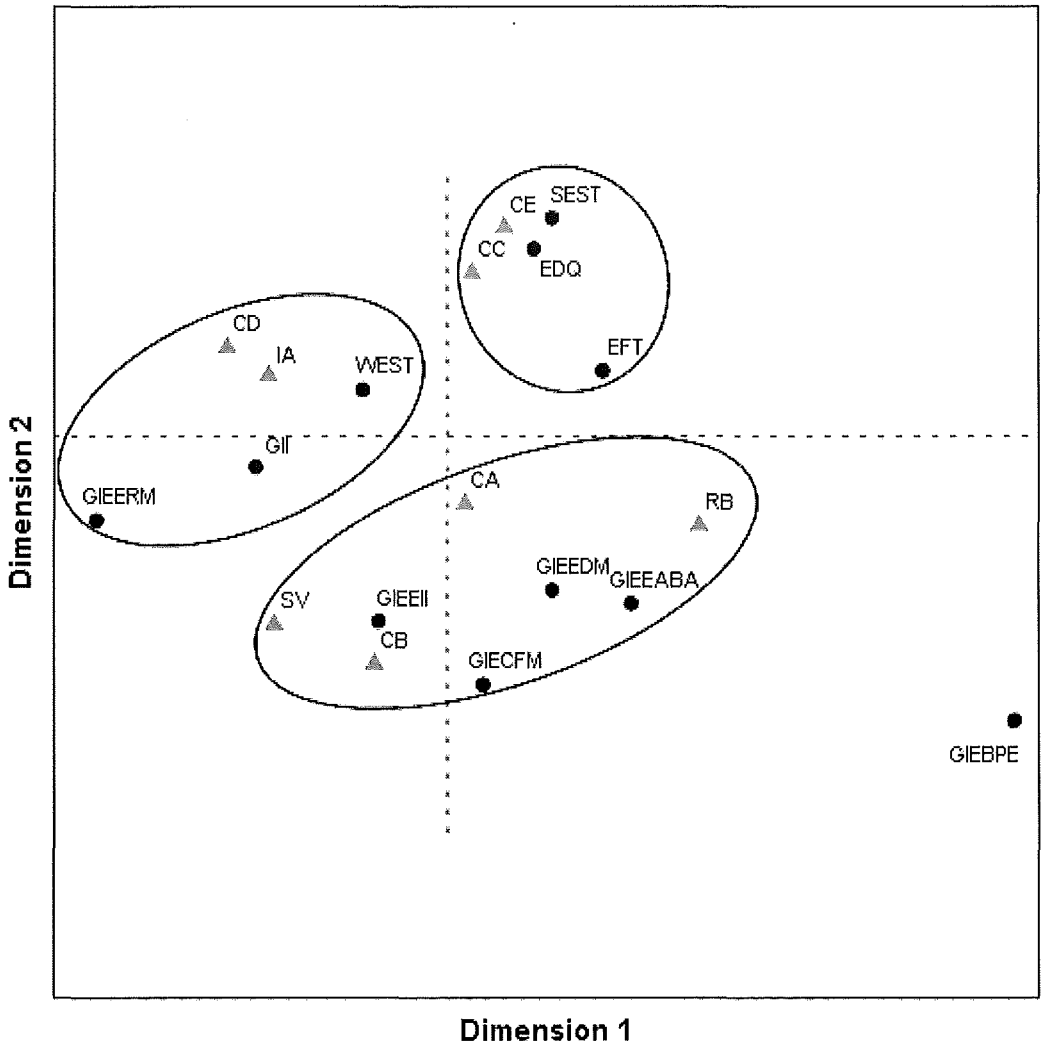

Figure 11: Concept and organisation perceptual map

Figure 11 above presents the two-dimensional perceptual map for both the concepts and organisations. The map presents three general clusters of concepts and organisations. The first cluster shows that corporate bank D and the industry body are associated with Green IS enabled environmental risk management (GIEERM), Green IS integration (GII), and weak environmental sustainability transformation (WEST), exposing their focus on Green IS integration (GII) to leverage Green IS enabled environmental risk management (GIEERM) for weak environmental sustainability transformation (WEST).

The second cluster illustrates that corporate banks C and E are associated with strong environmental sustainability transformation (SEST), environmental data quality (EDQ), and environmental-financial translation (EFT); that is, they are focused on environmental data quality (EDQ) and environmental-financial translation (EFT), and a basic level of strong environmental sustainability transformation (SEST), although corporate bank C is further away from strong environmental sustainability transformation (SEST).

The third cluster demonstrates that corporate banks A and B, the software vendor, and the retail bank are associated with Green IS enabled environmental information impartment (GIEEII), Green IS enabled environmental data management (GIEEDM), Green IS enabled environmental analysis (GIEEABA), and Green IS enabled carbon footprint management (GIECFM). Indeed, within this cluster the software vendor's close proximity to Green IS enabled environmental information impartment (GIEEII) and Green IS enabled carbon footprint management (GIECFM) is explained by their software offering that is focused on carbon footprint management and related reporting. In addition, the software vendor is away from Green IS enabled environmental data management (GIEEDM) and Green IS enabled environmental analysis (GIEEABA). Notably, the retail bank is the closest to Green IS enabled business process efficiencies (GIEBPE), which is one of their focuses.

5.5 Chapter summary and conclusions

Chapter Five expounded the framework development and corroboration. The objectives of the chapter have been met by exposing the emergent interrelationships between the conceptual categories and category properties in subsection 5.2, depicting the framework as a set of conceptual categories, category properties, and their interrelationships in subsection 5.2.4, and corroborating the framework through quantitative content and correspondence analysis in subsections 5.3 and 5.4. Thus, the goal of Chapter Five has been achieved, which was to answer the second research question, namely: how do the enabling and transforming capabilities of Green IS manifest and relate to environmental sustainability?

In conclusion, the analysis in Chapter Five exposed emergent and original theory in the form of the developed Green IS framework, which was grounded in the data presented in Chapter Four. Subsequently, the quantitative content and correspondence analysis corroborated the theoretical interpretations and facilitated deeper understanding of and insight into the data. The quantitative content and correspondence analysis demonstrated quantitatively the associations amongst the framework concepts, and in so doing corroborated the Green IS framework.

This chapter has value for academics by providing evidence of the value of using a mixed methods approach. This value is shown by the quantitative analysis enhancing the qualitative analysis. Importantly, the use of quantitative and qualitative analysis provides triangulation, which strengthens the research findings, improves the accuracy of inferences, and increases credibility. Additionally, this chapter has substantial value for industry and organisations especially in its product, being the developed and corroborated framework, which explicates the enabling capability of Green IS for environmental sustainability in banking organisations.

Chapter Six demonstrates verification of the framework by a focus group and member checking. Chapter Six details the focus group including its sampling and data collection specifics. In addition, the chapter details the feedback from the member checking process and explains the application of rigour.

Chapter 6: Framework Verification by a Focus Group and Member Checking

6.1 Chapter introduction

This chapter details the verification of the framework by an focus group of experts, following the framework's development and corroboration in Chapter Five. Subsequently, the researcher conducted member checking as an important credibility measure, and this is discussed. Thereafter, the application of rigour in the research is demonstrated. The findings from the focus group method and from the member checking are presented, both of which are justified and detailed in Chapter Three.

The goal of the chapter is to answer the third research question: according to experts, does the Green IS framework successfully capture the essential Green IS concepts and interrelationships to be relevant for environmental sustainability? This goal is achieved through the following chapter objectives: verify the framework and prove its relevance using the focus group method, prove the framework's credibility through member checking, and demonstrate the application of rigour.

Chapter Six continues with a detailed account and justification of the focus group sampling procedure and data collection process. Thereafter, the focus group findings are revealed and the modified Green IS framework is displayed. Next, the chapter details the member checking and the finalised Green IS framework is depicted. Subsequently, the application of rigour is demonstrated. Conclusions are then drawn and presented in subsection 6.5.

6.2 Focus group: framework verification

6.2.1 Sampling and data collection

As detailed in Chapter Three, the focus group provided conclusive evidence from knowledgeable and professional experts in the field for verification of the developed framework. The sampling procedure for the focus group was based on the principles justified in Chapter Three and mandated by the focus group method. In order to locate experts, the Internet was scrutinised using searches for sustainability experts, leaders, and management. Importantly, none of the interviewees from the grounded theory phase of the research could be selected as participants for the focus group. The necessary criteria for an expert were relevant knowledge and experience with regards to environmental sustainability and related IS aspects, time, willingness, and capacity to participate, and effective communication skills (Carey & Asbury, 2012).

Notably, including the criteria of time, willingness, and capacity to participate can be argued to have resulted in sampling bias, where those experts that do not have the time or capacity or are

unwilling to participate, are excluded. However, the objective of the focus group method was not statistical representativeness or generalisability based on random sampling (Carey & Asbury, 2012); instead, it was analytical generalisability and applicability based on purposive sampling. All the focus group participants met the expert knowledge and experience criteria concerning environmental sustainability and related IS aspects, which satisfied the objective of analytical generalisability and applicability and negated sampling bias.

Once an expert was identified, he/she was contacted via telephone or e-mail and requested to participate in the focus group by way of the focus group invitation letter. The invitation letter explained the focus group process, content, objectives, and benefits, indicated how the results may be of use, promoted interest, and encouraged commitment and participation. In some cases, the researcher was referred to another more suitable expert, who would be available to attend the focus group. The challenges in assembling a focus group include that experts usually have interests and needs that are different from those of the researcher, they have many other time pressures unrelated to this research, and they may have personal characteristics, roles, or fears that may limit commitment. The invitation letter aimed to mitigate these challenges.

The benefits of participation included being chosen as part of a select group, the opportunity for new learning through the process, increased visibility within the field, and the potential use of the findings. In addition, each participant received a monetary token of appreciation for their time away from work and travel; this is normally done for focus groups (Carey & Asbury, 2012). The experts were invited on a voluntary basis, so acceptance was an indication of sufficient capacity, willingness, and time to participate. All invited experts had positions requiring effective communication, so this criterion was also fulfilled at the time of invitation. In addition, all participants signed the required informed consent form prior to the focus group session.

Additionally, the focus group session was electronically recorded and subsequently transcribed by the researcher (Bryman & Bell, 2011). The discussion part of the session was scheduled for one hour, as detailed in Chapter Three, in order to prevent participant and moderator fatigue (Belanger, 2012). The researcher was dressed in a suit and tie, which is common attire for management; this created an acceptable first impression and one that the participants could easily relate to.

As detailed in Chapter Three, the researcher did not take an active role in the focus group. He was present during the focus group session only to do necessary administration, personally thank the participants, and perform an observer and note-taker role. During the session, the researcher did not participate in the discussions, in any way, either verbally or non-verbally. The session was moderated entirely by a university lecturer who was not involved in organisational sustainability in any way; this prevented any content bias on the part of the moderator. The

moderator was provided with the necessary terminology and context of the focus group before the session for an appropriate understanding of the research topic and questions. He was selected for his interpersonal skills gained through his previous experience as a teacher and crisis counsellor. During the session, the moderator displayed all the skills required of a focus group moderator and ensured that the focus group objectives were achieved.

The focus group took place in the boardroom of Chartered Secretaries Southern Africa (Chartered Secretaries Southern Africa, n.d.), located at the Riviera Road Office Park, Block C, 6 - 10 Riviera Road, Killarney, Johannesburg, on Tuesday 4 February 2014 from 10:45-12:00. Table 7 below shows justification for the expert status of the nine focus group participants.

Code	Current occupation	Organisation type	Relevant experience (description)	Relevant experience (years)	Qualifications
FG1	Recently retired partner and director	Leading auditing firm in South Africa	Leader for Integrated Reporting	> 10 years	PhD
FG2	Group sustainability manager	Large financial services company	Sustainability professional, sustainability reporting standard council member, and founder and director of a professional business fraternity promoting sustainable development projects	> 6 years	BSc Honours, Environmental Science and Climate Change
FG3	Information Systems professor (not related to this research in any way)	Large South African university	Professor with extensive experience in IS research	> 10 years	PhD
FG4	Sustainability reporting manager	Large South African bank	Consultant in sustainability and Integrated Reporting	> 5 years	Chartered Accountant (SA)
FG5	Environmental consultant and corporate lawyer	Consulting firm providing a variety of environmental legal services	Consultant and advisor to multinational and domestic companies on legal, tax and sustainability compliance, governance and risk management	> 20 years	MSc, Environmental Management
FG6	Project director for sustainability and Integrated Reporting	Leading accountancy body in South Africa	Consultant and author in sustainability and Integrated Reporting	> 5 years	Chartered Accountant (SA)
FG7	Manager operations evaluation	Government banking	Environmental specialist, portfolio planner, and environmental analyst	> 12 years	Information not provided
FG8	Independent sustainability advisor and consultant	Independent consultant	Sustainability consultant, adjunct faculty member at a leading business school, and advisory committee member on a United Nations sustainability body	> 7 years	PhD
FG9	Senior sustainability consultant	Sustainability strategy and management systems company	Consultant evaluating and promoting the role of business in global sustainable development, also a researcher, writer, and strategy consultant	> 7 years	MBA, Dual Concentrations: International Management, Strategy

Table 7: Focus group participants and their expert status

6.2.2 Findings - framework concepts

As stated in Chapter Three, grounded theory analysis was used, together with Atlas.ti (ATLAS.Ti, n.d.). The grounded theory coding analysis yielded expert opinion about the concepts and their interrelationships as depicted within the framework and about the overall framework itself. Firstly, the findings that relate to the concepts and their interrelationships, as depicted within the framework, are presented.

Several interaction effects were evident during the focus group session, especially in terms of group learning. On a number of occasions, an initial opinion was expressed and as participants joined that particular discussion, the initial opinion was developed into a more complete group opinion. Furthermore, initial opinions seemed to become more considered, in terms of the overall group discussion, as the discussions unfolded and other perspectives, experience, and information were provided.

Initially, there was consensus that the concepts depicted within the framework were very important and relevant. The enabling capability of Green IS, which is evident or manifests in a number of Green IS enabled management functions, was discussed first. The first Green IS enabled management concept was business process efficiencies and there were no apparent problems with this concept. The second concept was environmental data management and it was highlighted that in many cases reporting requirements dictate the data requirements and that qualitative environmental data is abundant, not just quantitative and non-financial environmental data.

The third concept was environmental analysis and there were no apparent problems with this concept. The fourth concept was environmental information impartment and it was requested that the name of this concept be changed to environmental information disclosure, in line with current business terminology. The importance of this concept was reiterated in terms of its ability to change organisational behaviour for environmental sustainability.

The fifth concept was carbon footprint management. The group indicated that this was not an equally important or an equally prioritised environmental concern across industries and even among organisations within an industry. The group indicated that ecological footprint management provided a more holistic concept for application to all organisations. Therefore, this concept's name was changed to carbon (and ecological) footprint management. Given that carbon footprint management is still a primary priority in the banking industry, and prevalent in comparison to the other ecological footprint items, the term carbon footprint management remains central to the concept. The sixth concept was environmental risk management and there were no apparent problems with this concept.

Following the Green IS enabled management functions were the moderating concepts, which determine how the enabling capability of Green IS affects environmental sustainability transformation. Many of the participants stated during the session that the moderating concepts were fundamental to the domain. The first moderating concept was Green IS integration and the participants acknowledged that Green IS need to be integrated into an organisation's core business processes. The second moderating concept was environmental data quality. The difficulty of achieving accurate and reliable environmental data, from which to report, make

decisions, and manage environmental sustainability, was highlighted. This emphasised that it is a key concept in the domain.

The third moderating concept was environmental-financial translation. While there was initial contention about assigning and being able to assign monetary values to all environmental interactions, group opinion developed that managing requires measuring, and monetary measures are a common unit of measurement for top management decision-makers. In addition, it was noted that environmental-financial translation would enable the development of business cases for new environmental initiatives and that tools are becoming publicly available to assist in assigning monetary values to environmental interactions.

Additionally, the environmental sustainability transformation concepts were discussed during the session. The first concept was weak environmental sustainability transformation. It was evident that the group did not separate environmental sustainability from a broader concept of sustainability that combines environmental sustainability, social sustainability, and economic sustainability. This conceptualisation falls within the definitions of weak environmental sustainability transformation. The second concept was strong environmental sustainability transformation and the group provided little acknowledgement of its application, which supports the data gathered beforehand in this research. In addition, the group was not clear about how to contrast global and organisational strong environmental sustainability, and how they relate to one another. Thus, the framework was modified to provide this clarity by separating the depiction of internal and external environmental sustainability transformation. Furthermore, the group acknowledged that economic sustainability is dependent on environmental sustainability, and that human mind-sets need to change in order to think long-term and collectively, which attests to the importance of strong environmental sustainability.

6.2.3 Findings - enabling and transforming capabilities

The group emphasised that Green IS do not have the capability to transform, being the intangible characteristic of Green IS to drive organisational transformation for environmental sustainability. This supports the data gathered beforehand in this research. The group did provide support for Green IS having an enabling capability, which is the intangible characteristic of Green IS that provides the means for environmental sustainability. However, the group felt that there was too little business context provided in the framework to appreciate how the enabling capability relates to the business drivers for sustainability. Subsection 6.2.4 details these concerns around context and the modifications made to the framework to address these concerns. As such, the findings that relate to the overall framework itself are presented in subsection 6.2.4.

6.2.4 Findings - framework context

The group indicated that environmental sustainability transformation drivers or forces should be incorporated into the framework even though environmental sustainability transformation is in response to many and varied drivers or forces not including Green IS. A few of these drivers or forces include exchange listing requirements, regulatory requirements, legislative requirements, Equator Principles, and investor and customer pressures. Detailing these forces is outside the objectives of this thesis, given that Green IS did not emerge as one of these forces, so they were excluded initially. However, including these does not detract from the research focus or impact the core of the framework, and does provide necessary contextual understanding of the framework for practitioners. Thus, a summary of the main drivers is included in the framework. The included drivers are reporting requirements, exchange listing requirements, compliance requirements, regulations and legislation, stakeholder pressures, risk management, and diminishing natural resources.

In addition, the group indicated that Green IS are enablers along with other complementary business enablers, namely leadership buy-in, employee communication, training, and acceptance, change management, and cross-sector, cross-business co-ordination and co-operation. Thus, these are similarly included in the framework to promote contextual understanding for practitioners without impacting the core of the framework. Additionally, the group pointed out that a feedback loop was required to provide information about the effectiveness of the framework. Such information can then be used to adapt the framework over time for optimal effectiveness, and to highlight to management which concepts require more or less focus. The feedback loop was included, again without impacting the core of the framework, and provides the necessary contextual understanding of the framework for practitioners.

The group viewed the framework as a potential tool for organisations, and following this, requested explicit elaboration about the users of the framework are, which unique problems are addressed, what the framework's preconditions are, how the framework should be used, and what the framework's intended outcomes are. These questions provide very useful context for practitioners, but require textual detail so they were not added to the framework figure; instead, they have been added directly after the framework figure as text. Again, the answers to these questions do not impact the core of the framework.

6.2.5 The modified Green IS framework

Importantly, the focus group did not result in significant changes to the core parts of the framework. It provided support for the framework's core concepts and their interrelationships. Essentially, the modifications to the framework as required by the focus group relate to

additional contextual detail to enhance its usefulness for practitioners. The suitability of the focus group method for verifying frameworks was detailed in Chapter Three, especially from the view that the framework is an artefact with potential use in industry and by the expert participants. Thus, the framework's core concepts and their interrelationships have been verified and are relevant based on expert evaluation, which is competent research evidence. Figure 12 below depicts the modified Green IS framework, which is based on the aforementioned focus group data analysis.

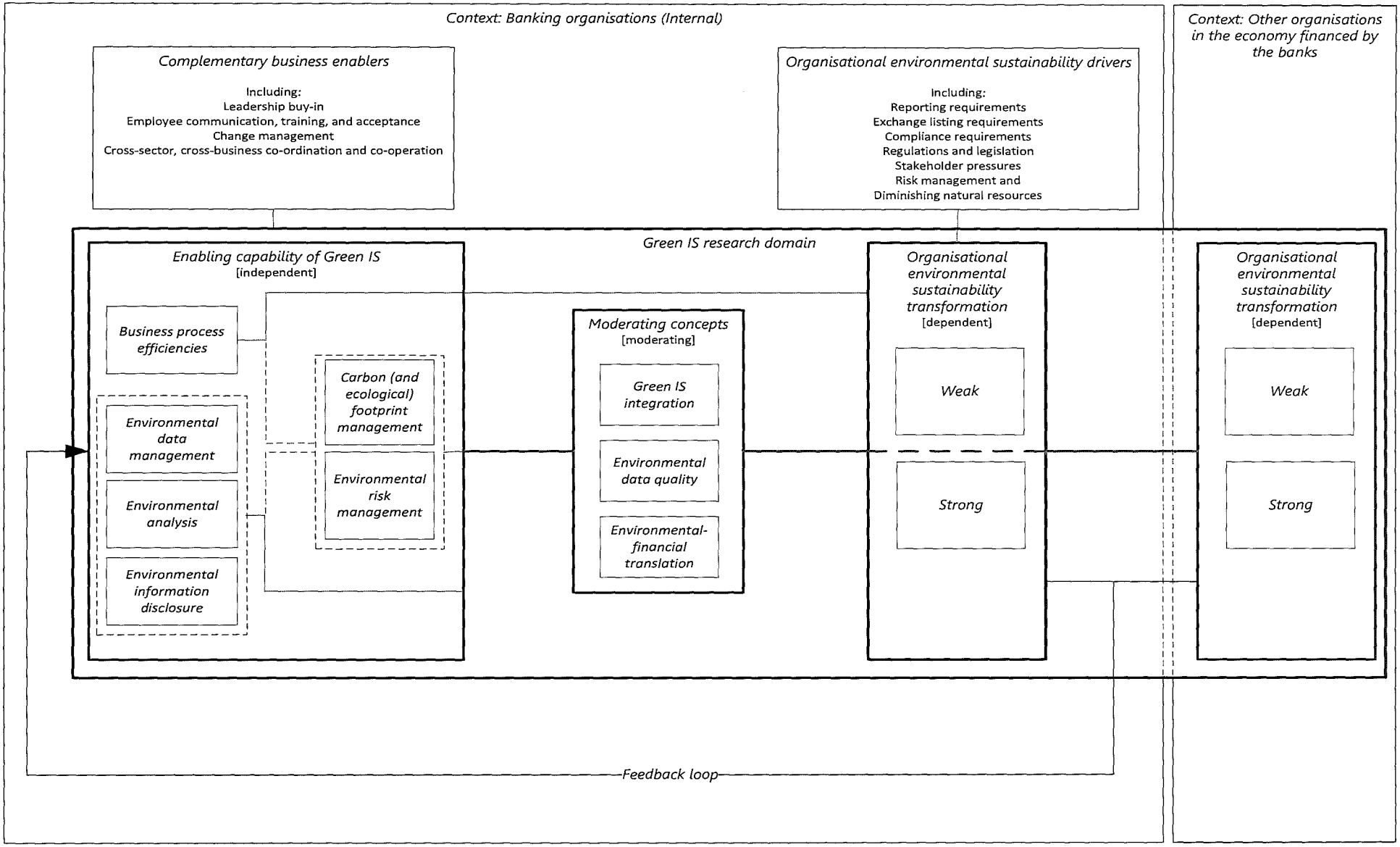

Figure 12: The modified Green IS framework

- Who are the users of the framework?

  The intended users of the framework are senior sustainability management in banking organisations. Although these managers are not responsible for the IS function within the bank, they drive the environmental sustainability processes and projects, and have influence in the corresponding budgets. Furthermore, they have a deep understanding of the environmental sustainability data, processes, analyses, reporting, foot printing, and risk management, including the associated opportunities and challenges. As such, these managers are ideally placed to assess how well their environmental sustainability management functions are being enabled by the organisation's IS and subsequently to affect any related IS change initiatives.

- What are the unique problems addressed?

  Generally, frameworks are highly beneficial for managers and the development of green frameworks provides direction, illustrates evolutionary paths, and depicts necessary changes. In addition, green frameworks ensure that organisations respond to environmental sustainability in a proactive manner, prevent wasted resources and poor returns on investment, and present opportunities for competitiveness and success. Specifically, this framework intends to address the lack of available guidance for banking organisations about how to leverage IS for environmental sustainability.

- What are the framework's preconditions?

  The framework is intended to be used in a corporate banking environment, where the corporate bank provides finance to other organisations throughout the economy for activities that impact the natural environment. There are no restrictions to the framework's use in terms of levels of corporate sustainability maturity. Notably, the framework may require adaptations in order to be applicable to other organisational settings.

- How should the framework be used?

  The framework is for use by senior sustainability management as a tool for facilitating understanding and subsequent effective action relating to Green IS for environmental sustainability. The framework allows management to focus attention on and allocate resources to Green IS for environmental sustainability, both within the banking organisation and throughout the economy via the bank's financing of external activities. The aims of the framework are achieved by exposing the key Green IS enabled management functions and moderating concepts, which are those aspects that critically affect the aforementioned environmental sustainability. Furthermore, the framework, with its contextual elaboration yet parsimonious structure, is a cross-departmental communication tool for creating shared understanding of the salient aspects, and for creating subsequent co-operation for

environmental sustainability. Importantly, in terms of leadership decision-making, the framework provides leadership with the key components and their relationships from which to determine optimal courses of action and optimal allocation of human, financial, and technological resources.

- What are the framework's intended outcomes?

  The intended outcome of the framework is a positive effect on the organisation's environmental sustainability transformation, both within the banking organisation and throughout the economy via the bank's financing of external activities. Another outcome of the framework's use is an awareness of where to focus management attention and resources to optimally affect the aforementioned environmental sustainability transformations.

6.3 Member checking

6.3.1 Sampling and data collection

As detailed in Chapter Three, member checking is considered one of the most important provisions for research credibility and provides verification of the researcher's emerging theories and inferences (Shenton, 2004). Member checking involves presenting the research findings to key informants to determine whether they can recognise their experiences in the findings (Krefting, 1991). Such recognition of their experiences in the findings demonstrates that the research is credible and that the researcher has accurately translated the informants' perspectives of the domain. It also decreases the chances of misrepresentation (Krefting, 1991). With the exception of an additional software vendor, detailed and justified in subsection 6.3.8 below, the key informants for member checking were the original interviewees from the grounded theory phase of the research. Of all the original interviewees, only corporate bank D and the industry body did not provide feedback due to work pressures.

6.3.2 Corporate bank A

The member from this originally interviewed corporate bank attested to the framework's usefulness for environmental sustainability experts. One of the key aspects mentioned by this interviewee was the concept of integration, which is a central aspect of the framework. The interviewee indicated that this large bank had progressed quite far already in embedding sustainability and it was important to highlight integration within a large bank with many departments and divisions, and a wide geographical spread. In addition, the interviewee suggested that the framework would be useful in smaller banks too, where sustainability is at an inception phase.

6.3.3 Corporate bank B

The member from this originally interviewed corporate bank indicated that the framework was useful in terms of Green IS. This member found the framework's depiction of the complementary business enablers particularly useful, namely leadership buy-in, employee communication, training, and acceptance, and cross-sector, cross-business co-ordination and co-operation. Again, the moderating concept called integration was an especially important focus for this member. The member highlighted that the direct environmental impact of the bank was not nearly as significant as its indirect environmental impact through its financing and investment in the economy. This is further evidence of the pivotal role that banks occupy for environmental sustainability throughout the economy. The member mentioned that the framework was comprehensive in its depiction of the direct impact aspects but suggested that the investment and financing aspects be emphasised. The framework was modified to highlight the investment and financing aspects as an additional label in the framework depiction.

6.3.4 Corporate bank C

The member from this originally interviewed corporate bank indicated that the framework was useful especially as a communication tool in meetings and that it provided a prescriptive structure for banks relating to Green IS management. The member recognised his own organisation's transformation in the framework, particularly in terms of carbon footprinting, where this organisation was strong. The member stated that the framework could be a useful persuasion tool within the organisation and that it highlighted the main issues involved. The member suggested that the framework could be easily expanded to include social sustainability. However, the focus of this research was environmental sustainability, which has been justified, so no modifications have been made to the framework as suggested by this member to incorporate social sustainability.

6.3.5 Software vendor

The two members from this originally interviewed sustainable computing and green ICT organisation were very impressed with the framework, stating that it was very useful because it conceptualised the role of Green IS in the sustainability domain. In particular, the framework demonstrated the relationship between Green IS and the corporate sustainability drivers. The member made a point that although the framework depicted environmental risk management as having an external focus, in the member's experience it similarly had an internal focus. The framework was modified to indicate that environmental risk management involves both an internal and an external focus. However, the primary focus, as emerged from the data from all

the participants, is an external focus. Thus, this addition is added as a label only on the framework depiction.

6.3.6 Retail bank

The member from the originally interviewed retail bank was very impressed with the framework, especially with the moderating concept called environmental-financial translation. The member found this to be a key concern when presenting to the organisation's board members and management, who require financial translation in order to make sensible business decisions on sustainability. The other aspect that the member highlighted was environmental data quality, because this was an issue in the organisation especially due to its particular dependence on human data entry. The framework highlights this issue. Overall, the member thought that the framework was useful to business.

6.3.7 Corporate bank E

The member from the originally interviewed corporate bank indicated that the organisation currently did not have such a framework and required one. The original member invited a colleague to attend the feedback meeting for the colleague's deep IT knowledge. The invited colleague was in a specialist management position from the banking group's IT or technology division. This additional key informant signed an informed consent form prior to the feedback meeting. Neither member had any problems with the enabling capability of Green IS concepts, the moderating concepts, or the environmental sustainability transformation concepts.

The invited colleague indicated that the drivers may be South African and international for banks that have an international influence. This was noted in the framework depiction. In addition, the original member did suggest several changes to the layout of the framework depiction, such as displaying it on A3-size paper, using colour indications for internal focus and external focus, and adding balloon comments to each concept for relating these to the organisation's specific systems, process, and drivers. Given the uniqueness of these suggestions, the level of abstraction required by the research, and reference to the feedback from all the other members, the framework was further modified only to clarify the internal or external focus of the applicable concepts, and to clarify that the complementary business drivers and environmental sustainability transformation drivers are for context only and not central to the justified research objectives.

6.3.8 Additional software vendor

A final check was done with an organisation that was not involved in the research in any way. This organisation was approached because of its particular prominence as a corporate

sustainability software vendor. The key informant providing the feedback on the framework was the head of sustainability at the organisation. The informant indicated that the framework was generally good as it highlighted the many important issues in sustainability and Green IS. Importantly, the participant stated that Green IS do not drive sustainability but rather enable it. This is further evidence of the enabling capability of Green IS, and the absence of the transforming capability of Green IS. The informant reiterated the importance of the sustainability drivers in the framework, especially a risk register, shareholder value, and return on investment (ROI). The framework was modified to include these additional drivers. In addition, the informant recognised the importance of leadership buy-in, collaboration, and integration, which are depicted in the framework. This key informant signed an informed consent form prior to the feedback.

6.3.9 The finalised Green IS framework

Similar to the focus group, the member checking did not significantly change the core parts of the framework. It provided support for the framework's core concepts and their interrelationships. Essentially, the modifications to the framework as required by the members relate to additional contextual detail to enhance usefulness for practitioners. The main feedback received was that the framework conceptualised the role of Green IS in the sustainability domain, and it would be useful in practice for its purpose. Thus, the framework has been shown to be credible, relevant, and verified. Figure 13 below depicts the finalised Green IS framework, which is based on the aforementioned input from the members.

Importantly, the concepts and their interrelationships depicted in the finalised Green IS framework, Figure 13 below, were developed through grounded theory in the banking sector. This ensured that these concepts and their interrelationships were grounded in data specifically from the banking sector. Therefore, these concepts and their interrelationships emerged from and are directly applicable to the banking sector. Importantly, the applicability of these concepts and their interrelationships to other industries, including other types of financial services such as the insurance industry, relates to the transferability of the framework, which is detailed in subsection 6.4.2. Figure 13 below in conjunction with the entire thesis document provides the necessary information for a user of the research to determine whether the framework can be applied equally to other industries familiar to that user. Notably, the applicability of the concepts and their interrelationships depicted in the finalised Green IS framework, Figure 13 below, were enhanced by the focus group method. The focus group method's objective was not statistical representativeness or generalisability (Carey & Asbury, 2012); instead, it was analytical generalisability and applicability. Analytical generalisability and applicability of the findings to

many settings and contexts were achieved by the provision of data from experts, who had extensive experience of many relevant settings and contexts (Belanger, 2012), including other industries and other types of financial services such as the insurance industry. Further research, as indicated in subsection 7.9, will be needed to extend or modify this framework for industries outside of banking.

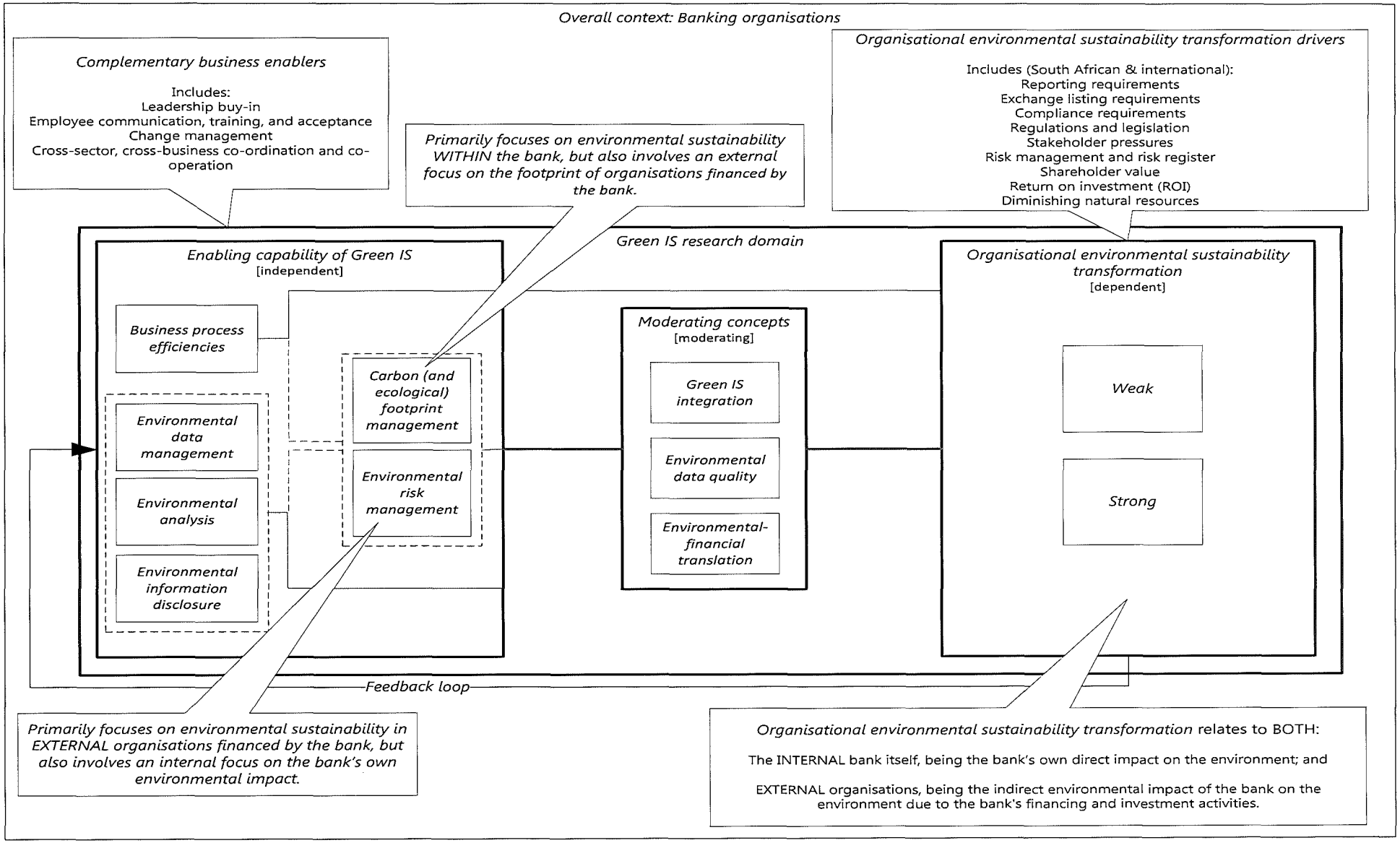

Figure 13: The finalised Green IS framework

- Who are the users of the framework?

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- What are the unique problems addressed?

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environmental sustainability. Importantly, in terms of leadership decision-making, the framework provides leadership with the key components and their relationships from which to determine optimal courses of action and optimal allocation of human, financial, and technological resources.

- What are the framework's intended outcomes?

  The intended outcome of the framework is a positive effect on the organisation's environmental sustainability transformation, both within the banking organisation and throughout the economy via the bank's financing of external activities. Another outcome of the framework's use is an awareness of where to focus management attention and resources to optimally affect the aforementioned environmental sustainability transformations.

6.4 Research rigour

Rigour in research is paramount, and the following sections attest to the application of rigour in the research. The research is assessed based on the following appropriate qualitative criteria (Shenton, 2004): trustworthiness (Morse, Barrett, Mayan, Olson, & Spiers, 2002), authenticity (Bryman & Bell, 2011), and adequacy. Furthermore, trustworthiness has four aspects, namely credibility, transferability, dependability, and confirmability (Bryman & Bell, 2011). For research founded on positivism, credibility can be viewed as the qualitative perspective on internal validity, transferability as the qualitative perspective on external validity and generalisability, dependability as the qualitative perspective on reliability, and confirmability as the qualitative perspective on objectivity (Shenton, 2004).

6.4.1 Credibility

6.4.1.1 Introduction

Credibility attempts to ensure that a true depiction of the phenomena being studied is portrayed (Shenton, 2004). In the research, credibility was ensured by adopting of well-established research methods, developing an early understanding of the culture of the participating organisations, implementing an appropriate sampling technique, employing tactics to encourage honesty in informants, applying iterative questioning, conducting negative case analysis and reflective researcher commentary, providing thick descriptions of the phenomena being studied, examining of findings from previous research, and conducting member checks (Shenton, 2004). Importantly, member checks are detailed in subsection 6.3.

6.4.1.2 Adoption of well-established research methods

The adoption of well-established research methods is evident in the adoption of the grounded theory and focus group methods. These methods are both well established in general qualitative

research and in IS research (Urquhart *et al.*, 2010; Urquhart, 2001; O'hEocha *et al.*, 2012; Tremblay *et al.*, 2010). Furthermore, the grounded theory method was well suited to the sub-objective of developing a framework (Charmaz, 2006) and theory development (Corbin & Strauss, 2008; Glaser & Strauss, 1967), contrasting it with other research approaches (Butler & O'Reilly, 2010; Rodon & Pastor, 2007). In addition, the focus group method was well suited to the sub-objective of verifying the framework and showing relevance (Rosemann & Vessey, 2008; O'hEocha *et al.*, 2012). Additionally, content analysis and correspondence analysis are established and applicable research methods, suited to corroboration of the framework (Venkatesh *et al.*, 2013; Siponen & Vance, 2010; Greenacre & Lewi, 2009; Greenacre, 2006). Furthermore, member checking is an established method for research credibility, relevance, and verification (Shenton, 2004; Krefting, 1991).

6.4.1.3 Early understanding of the culture of the participating organisations

The researcher developed an early understanding of the culture of the participating organisations, being banking organisations in South Africa, as a result of the researcher's previous employment. The researcher was employed in various banking organisations for almost 8 out of the last 14 years, giving him a deep understanding of the culture of the participating organisations in addition to their influence on organisations throughout the economy.

6.4.1.4 Implementing an appropriate sampling technique

As justified in Chapter Three, appropriate sampling techniques were employed throughout the research, according to each method used. A summary of these sampling techniques follows. In grounded theory it is not possible to predetermine, prescribe, preplan, or predefine samples for data collection; instead, theoretical sampling is mandated and determines samples as the research continues (Glaser & Strauss, 1967; Corbin & Strauss, 2008; Charmaz, 2006; Rodon & Pastor, 2007; Urquhart *et al.*, 2010). Theoretical sampling is not about achieving statistical generalisability; it is about fitting emerging theories with data (Charmaz, 2006). It determines samples and interview questions based on their theoretical relevance for furthering the development of the emerging theory and based on the theoretical purposes of maximising or minimising both differences and similarities of data (Glaser & Strauss, 1967; Corbin & Strauss, 2008; Charmaz, 2006; Orlikowski, 1993). Theoretical sampling is essentially controlled by the emergent theory (Glaser & Strauss, 1967; Corbin & Strauss, 2008; Charmaz, 2006).

In the focus group method, sampling is purposive in order to obtain participants with a thorough understanding and knowledge of the topic (Carey & Asbury, 2012). The objective of the focus group method is not statistical representativeness or generalisability (Carey & Asbury, 2012); instead, it is analytical generalisability and applicability that is the objective. Analytical

generalisability and applicability of the findings to many settings and contexts are achieved by the provision of data from experts, who have extensive experience of many relevant settings and contexts (Belanger, 2012).

In addition, sampling for the member checking, with the exception of an additional software vendor, as justified in subsection 6.3 of this chapter, were the original interviewees from the grounded theory phase of the research.

6.4.1.5 Employing tactics to encourage honesty in informants

Employing tactics to encourage honesty in informants is evident by the researcher explicitly stating to each interviewee that participation was voluntary, he/she had the right to privacy, the right not to participate, the right to withdraw, the right to informed consent, the right to anonymity, and the right to confidentiality, and therefore any information that was provided would remain private, anonymous, and confidential, and no one would be able to trace responses back to an interviewee as a person or to an interviewee's organisation in any published record of the research. The researcher only asked about issues which an interviewee was expected to feel comfortable discussing. If an interviewee did not feel comfortable answering a question, the interviewee was welcome not to answer it. In addition, the research employed iterative questioning to promote honesty. Furthermore, the researcher established a rapport as early as possible through small talk that involved discussing the weather and general news.

6.4.1.6 Iterative questioning

Iterative questioning is evident in the conduct of the semi-structured interviews, where questions were rephrased and asked later in the interview to improve integrity and consistency of data. Any discrepancies and dishonesty were then analysed, coded correctly, and presented in the findings.

6.4.1.7 Negative case analysis

Negative case analysis is evident in theoretical sampling where a negative instance, the retail bank, was sought and accessed to elaborate the emerging categories and patterns, and ensure that the categories accounted for all instances of the research phenomena.

6.4.1.8 Reflective researcher commentary

Reflective researcher commentary is evident in the use of a central mechanism for this, being grounded theory memo writing. Memos were used throughout data analysis to record and develop the researcher's analytic insights (Corbin & Strauss, 2008; Allan, 2007). Memo writing actively engages the researcher with the data, increases the level of abstraction of ideas, crystallises questions, and directs subsequent theoretical sampling (Charmaz, 2006).

6.4.1.9 Thick descriptions of the phenomena being studied

Thick descriptions of the phenomena being studied are evident both in the framework development process and in the developed and presented framework. These descriptions not only explicate the conceptual categories, category properties, and their interrelationships, but also position the developed framework firmly in its context so that it becomes meaningful for the users of the research.

6.4.1.10 Examination of findings from previous research

Examination of findings from previous research is evident in the systematic literature review, which provides both the initial theoretical sensitivity to the salient concepts and contexts concerning the research, and a final relation of its knowledge contribution to the existing body of knowledge, which is detailed in Chapter Seven. Indeed, grounded theory supports reviewing the literature before conducting empirical data collection; however, care was taken not to allow the existing theories in the literature to distort any emerging theory (Glaser & Strauss, 1967; Corbin & Strauss, 2008; Charmaz, 2006; Urquhart *et al.*, 2010). Again, the literature is important for gaining theoretical sensitivity to the salient concepts and contexts concerning the research (Allan, 2003; Urquhart & Fernandez, 2006; Rodon & Pastor, 2007).

6.4.2 Transferability

Transferability relates to the applicability of research findings to other settings (Shenton, 2004). This is evaluated in the context of interpretivism, where there is no single absolute account of social realities such as organisational and business environments (Bryman & Bell, 2011). In the research, transferability was ensured through a data analysis process congruent with grounded theory for developing a thick or dense description (Krefting, 1991). The thick or dense description is evident in the elaboration of the phenomena being studied, the corresponding research processes, and background information about the informants, all of which position the developed framework firmly in context for users of the research and ensure transferability. Such elaboration enables a user of the research to determine whether the findings can be applied to other situations familiar to that user. Importantly, the research provides the following key information to the users of the research in consideration of transferability (Shenton, 2004), namely how many organisations were involved, which types of organisations were involved, how they were selected, where they were located, what their important characteristics were, how many key informants were involved, how they were selected, what their important characteristics were, what data collection methods were used, how they were used, how many data collection sessions there were, how long each one was, and what the period was over which data was collected.

This is essentially an audit trail, or dense description, of all the research decisions taken and clarifies how repeatable the research may be or how unique it may be. As such, items that are also included in the stored records of the research as an audit trail are the raw data or audio recordings, the data analyses involving the development of the conceptual categories, category properties, and their interrelationships, research design strategies, research evaluation criteria, instrument development and pretest information, data collection formats, and schedules.

6.4.3 Dependability

Dependability refers to the audit trail of the research or to the extent that complete records of the research process were kept (Bryman & Bell, 2011). In the research, dependability was ensured with detailed and complete records of interview voice data, interview transcripts, interviewee selection criteria, and data analyses. Management, organisation, and storage of the interview transcripts and data analyses were facilitated through Atlas.ti (ATLAS.Ti, n.d.), which provides a central and accessible audit object.

6.4.4 Confirmability

Confirmability refers to showing that the researcher has acted in good faith and not overtly permitted theoretical inclinations to influence the research process and research findings (Bryman & Bell, 2011). In the research, confirmability was ensured by exposing a rigorous grounded theory process, which substantiates that the developed framework is grounded in the data. In addition, the literature review was used only for gaining the necessary theoretical sensitivity to the salient concepts and contexts concerning the research (Glaser & Strauss, 1967; Allan, 2003; Urquhart & Fernandez, 2006; Rodon & Pastor, 2007; Urquhart *et al.*, 2010).

6.4.5 Authenticity

Authenticity relates to aspects concerning the wider political impact of research, and is composed of the following criteria: fairness, ontological authenticity, educative authenticity, catalytic authenticity, and tactical authenticity (Bryman & Bell, 2011). In the research, fairness was shown by interviewing directors, senior level managers, and specialist managers. This provided perceptions from those who were accountable for strategy, management, and operations. Ontological authenticity is demonstrated in the framework, which provides a deeper understanding about the relationship between Green IS and environmental sustainability and how to leverage Green IS for environmental sustainability. Educative authenticity is demonstrated by this research providing a collective member perspective, allowing each member to appreciate the collective perspective through the developed framework. Catalytic authenticity is demonstrated in the practical usefulness of the framework to improve environmental sustainability by

leveraging Green IS. Additionally, tactical authenticity is demonstrated by the framework providing practical direction for members in leveraging Green IS for environmental sustainability.

6.4.6 Adequacy

Adequacy relates to the amount of data collected and whether or not saturation occurred. In the research, adequacy was ensured through theoretical sampling. Specifically, sampling adequacy was ensured by engaging only those interviewees who best represented or had knowledge of the research topic; such interviewees were filtered by the aforementioned selection inclusion and exclusion criteria (Graneheim & Lundman, 2004). The resulting sampling adequacy provided sufficient data to account for all aspects of the phenomena under investigation and ensured efficient and effective saturation of categories, which is the point when no additional data is being found that further develops a category, its properties, and variations (Glaser & Strauss, 1967; Corbin & Strauss, 2008; Charmaz, 2006; Orlikowski, 1993). Importantly, computer software called Atlas.ti (ATLAS.Ti, n.d.) was used to support the grounded theory data analysis activities and it provided auditable evidence of theoretical sampling and saturation. All supporting documentation and analysis are stored and maintained within Atlas.ti. In this regard, during analysis of the final interviews, saturation was evident by the repeated use of codes from the code list developed from the preceding interviews, and consequently, there was no development of new conceptual categories, category properties, and their interrelationships.

6.5 Chapter summary and conclusions

Chapter Six detailed the verification of the framework by an expert focus group, following the framework's development and corroboration in Chapter Five. In addition, member checking was demonstrated as an important credibility measure that was conducted by the researcher subsequent to the focus group. Furthermore, the application of rigour has been shown.

The objectives of the chapter have been met in that the framework has been verified and its relevance proved in subsection 6.2 using the focus group method, the framework's credibility has been proved through member checking in subsection 6.3, and the application of rigour has been demonstrated in subsection 6.4. Thus, the goal of Chapter Six has been achieved, which was to answer to third research question: according to experts, does the Green IS framework successfully capture the essential Green IS concepts and interrelationships to be relevant for environmental sustainability?

In conclusion, the focus group verified the framework's core concepts and their interrelationships. Furthermore, it demonstrated the framework's relevance through expert evaluation, being competent research evidence. Subsequently, the framework was verified

through member checking, providing credibility that the framework conceptualises the role of Green IS in the sustainability domain, is relevant, and will be useful in practice for its purpose. In addition, evidence was provided on the attainment of rigour in the research.

This chapter has value for academics by demonstrating the suitability and application of the focus group method for framework verification and relevance. Furthermore, value is provided in the use of member checking to provide credibility, relevance, and verification. Importantly, the assessment of rigour in the chapter provides the criteria and their assessment for evaluating rigour in similar research. Additionally, this chapter has substantial value for industry and organisations as it provides expert input and member feedback attesting to the framework's relevance and suitability for practitioners.

The next chapter, Chapter Seven, contains the overall research conclusions. These conclusions are based on all the preceding chapters. Importantly, it is shown in Chapter Seven that the research problem has been addressed, the research questions answered, and the research objective achieved. Chapter Seven presents management guidelines and recommendations for environmental sustainability based on the findings from Chapters Four, Five, and Six.

Chapter 7: Research Conclusions

7.1 Chapter introduction

Chapter Seven contains the overall research conclusions based on all the preceding chapters. The goal of the chapter is to present the outcomes or conclusions of the research. This goal is achieved through the following chapter objectives: demonstrate that the research problem is addressed, the research questions are answered, and the research objective is achieved, present management guidelines and recommendations for environmental sustainability, and explain the value of the research for academics.

Chapter Seven continues with a summary of the findings, a discussion relating the finalised, empirical framework back to Chapter Two's literature review, and details an anomalous finding. Thereafter, it is shown that the research problem has been addressed, the research questions have been answered, and the research objective has been achieved. Following this are management guidelines and recommendations and the value for academics. Subsequently, the chapter presents the limitations and future research opportunities. Conclusions are then drawn and presented in subsection 7.10.

7.2 Summary of the findings

The mixed methods approach, explained and justified in Chapter Three, produced findings from its grounded theory method, its content and correspondence analysis, its focus group method, and its member checking. Subsection 7.2 contains a summary of the findings from each of these research methods and processes.

7.2.1 Grounded theory method

Chapters Four and Five detailed the following summary of findings. The aim of the grounded theory method was to develop the necessary theory to achieve the research objective. Core categories that emerged from the data are environmental sustainability transformation and the enabling capability of Green IS. Two main types of environmental sustainability transformation are prevalent, namely the concepts of weak and strong environmental sustainability transformation.

The enabling capability of Green IS is the intangible characteristic of Green IS that provides the means for environmental sustainability, which indicates a causal relationship between the enabling capability of Green IS and the environmental sustainability transformation. In this relationship, the enabling capability of Green IS is considered the independent variable and the environmental sustainability transformation the dependent variable.

Within the enabling capability of Green IS core category, there are six category properties. Each property is an emergent and salient aspect of the researched domain that is enabled by Green IS, and is a manifestation or evidence of the enabling capability of Green IS. In other words, the enabling capability of Green IS manifests or is evident in six Green IS enabled management functions or category properties. These properties are business process efficiencies, environmental data management, environmental analysis, environmental information impartment, carbon (and ecological) footprint management, and environmental risk management.

Importantly, three pertinent concepts emerged from the data that moderate the indicated relationship between the enabling capability of Green IS and the environmental sustainability transformation. These concepts have a contingent effect on the relationship, which means that the relationships are dependent on and affected by the existence of these moderating concepts. These moderating concepts are aspects that determine how the enabling capability of Green IS affects environmental sustainability transformation. The data indicates that if there is a good (poor) level of the moderating concepts with regard to the enabling capability of Green IS, then there is a resultant improvement (deterioration) in the level of environmental sustainability transformation. These concepts are Green IS integration, environmental data quality, and environmental-financial translation. Green IS integration relates to the level of integration of Green IS into the current organisational systems and processes. Environmental data quality relates to the level of environmental data quality. Environmental-financial translation relates to the level of assignment of economic value or monetary values to the organisation's environmental interactions.

7.2.2 Content and correspondence analysis

Chapter Five detailed the following summary of findings. The content analysis provided basic descriptive statistics and the quantitative input into the more complex correspondence analysis. From an overall organisational perspective, content analysis demonstrated the prevalence of weak environmental sustainability transformation and the lack of strong environmental sustainability transformation. Content analysis also illustrated the relative importance of the enabling capability of Green IS core category properties. In addition, the content analysis demonstrated the importance of the moderating concepts of Green IS integration, environmental data quality, and environmental-financial translation, in relation to the enabling capability of Green IS core category properties. In particular, the moderating concept of environmental data quality showed great importance, which is evidence that in this particular domain environmental data quality is a particularly significant aspect.

Correspondence analysis was then conducted to expose the systematic relationships amongst all the concepts while accounting for all the information in the data. The main correspondence analysis output was a two dimensional perceptual map of the concepts. The map shows a general vertical axis split, where the top rectangle grouping incorporates the concepts of weak environmental sustainability transformation, strong environmental sustainability transformation, Green IS integration, environmental data quality, and environmental-financial translation. These are the framework concepts relating to the environmental sustainability transformation core category, and the concepts that moderate the relationship between the enabling capability of Green IS core category and environmental sustainability transformation core category. This suggests that these moderating concepts are associated with environmental sustainability transformation.

The bottom rectangle grouping incorporates all the Green IS enabling capability core category properties and suggests that there is a Green IS enabling capability core category association among them. In addition, there are a number of closely grouped clusters, which further demonstrate the associations among these concepts. Importantly, the quantitative content and correspondence analysis corroborated the theoretical interpretations from the grounded theory method, and facilitated deeper understanding of and insight into the data. Furthermore, the quantitative content and correspondence analysis demonstrated quantitatively how the framework concepts are associated with one another, and in so doing corroborated the Green IS framework developed during the grounded theory phase of the research.

The aforementioned enabling capability of Green IS core category and its properties, the environmental sustainability transformation core category and its properties, the moderating concepts, and corresponding interrelationships form the Green IS framework, which was depicted in Chapter Five.

7.2.3 Focus group method

Chapter Six detailed the following summary of findings. The aim of the focus group method was to provide conclusive evidence from knowledgeable and professional experts in the field for verification of the developed framework. Interaction effects were evident during the focus group session, especially in terms of group learning. On several occasions, an initial opinion was expressed and as participants joined that particular discussion, the initial opinion was developed into a more complete group opinion. Furthermore, initial opinions seemed to become more considered, in terms of the overall group discussion, as the discussions unfolded and other perspectives, experience, and information were provided. Nevertheless, the focus group did not result in significant changes to the core parts of the framework that was presented in Chapter

Five. The focus group provided support for the framework's core concepts and their interrelationships. Essentially, the modifications to the framework as required by the focus group related to additional contextual detail to enhance its usefulness for practitioners. The suitability of the focus group method for verifying frameworks was detailed in Chapter Three, especially from the view that the framework is an artefact with potential use in industry and by expert participants. Thus, the framework's core concepts and their interrelationships have been shown to be verified and relevant through expert evaluation, which is competent research evidence. Chapter Six depicted the modified Green IS framework, which was based on the aforementioned focus group data.

7.2.4 Member checking

Chapter Six detailed the following summary of findings. The aim of the member checking was to provide credibility to the research and further verify the framework. Similar to the focus group, the member checking did not significantly change the core parts of the framework that was presented in Chapter Five. The member checking provided support for the framework's core concepts and their interrelationships. Essentially, the modifications to the framework as required by the members related to additional contextual detail to enhance usefulness for practitioners. The main feedback that was received was that the framework would be useful in practice for its purpose, and that it conceptualised the role of Green IS in the domain. Thus, the framework has been shown to be credible, and the framework's core concepts and their interrelationships have been further verified. Chapter Six depicted the finalised Green IS framework, which was based on the aforementioned input from the members.

7.3 Relation to the literature review

The literature review culminated in a sensitising theoretical framework based entirely on the literature. This framework and the sparseness thereof demonstrated and justified the need for the empirical work in this research, which was to develop and verify an empirical Green IS framework that explicates the enabling and transforming capabilities of Green IS for environmental sustainability.

Importantly, the sensitising theoretical framework exposes the implicit indications in the literature that the transforming and enabling capabilities of IS apply to the environmental sustainability domain. However, there is no elaboration in the literature as to the nature of these transforming and enabling capabilities of Green IS, nor how they relate to environmental sustainability. Thus, in a research domain that affects the broad public it was vital to conduct research to expose these transforming and enabling capabilities.

The empirical part of this research yielded the necessary elaboration of the transforming and enabling capabilities of Green IS, making an original contribution to the academic body of knowledge. The finalised Green IS framework demonstrates the salient manifestations of the enabling capability of Green IS and shows the absence of the transforming capability of Green IS. In addition, the empirical part of this research defined the moderating concepts. While the finalised framework's moderating concepts of environmental data quality and environmental-financial translation are similar to the sensitising theoretical framework's moderating concepts of environmental information quality and economic value, respectively, the third moderating concept of Green IS integration emerged from the data as an entirely new moderating concept. Furthermore, the sensitising theoretical framework's moderating concept of environmental strategy and management did not emerge from the data as a moderating concept in the domain, but instead a related concept called leadership buy-in emerged as a complementary business enabler only.

Additionally, the mediating concept called fundamental business changes, in the sensitising theoretical framework, did not emerge from the data, which is due to the absence of the transforming capability of Green IS. The remaining concepts in the sensitising theoretical framework are internal strong environmental sustainability and external strong environmental sustainability. The data demonstrates that weak environmental sustainability is prevalent while strong environmental sustainability is evident to a much lesser extent, and this applies to both internal and external environmental sustainability. As such, the comparable concept emerging and fitting the data was environmental sustainability transformation with the properties of weak and strong environmental sustainability.

The aforementioned summary of the finalised Green IS framework in relation to the literature emphasises the need for conducting the empirical research and provides evidence that the finalised Green IS framework has made an original contribution to the academic body of knowledge. This research has explicated the enabling capabilities of Green IS by way of a management framework for South African banks.

7.4 Anomalous findings

A finding that may be considered an anomaly from the perspective that it was an unexpected finding was the absence of the transforming capability of Green IS. Following the research justification in Chapter One and the subsequent research questions, especially research question 2, the literature suggested the existence of the transforming capability of Green IS. The transforming capability is the intangible characteristic of Green IS to drive organisational transformation for environmental sustainability. The data evidence shows that there are many

and varied forces transforming the banks in terms of environmental sustainability, but Green IS is not one of these transforming forces. This emerged in the grounded theory data detailed in Chapter Four and was verified by the focus group data given in Chapter Six. Thus, while this finding does provide a conclusive and valuable answer to that part of research question 2, it is nevertheless an unexpected finding.

7.5 Research questions answered and research objective achieved

The concept of environmental sustainability was an important directing concept for this research, and consequently the first research question was: what is environmental sustainability and why is it important? This research question was answered in Chapter Two, specifically in section 2.5.1, by fully elucidating the concept, establishing its significance, defining its fundamental principles, and uncovering its implications for organisations.

The second research question was: how do the enabling and transforming capabilities of Green IS manifest and relate to environmental sustainability? This question was answered in Chapters Four and Five. Specifically, Chapter Four demonstrated the implemented grounded theory process as a competent base for the framework development and corroboration detailed in Chapter Five. Subsequently, in Chapter Five the emergent interrelationships between the concepts were shown by depicting the framework as a set of conceptual categories, category properties, and interrelationships. In addition, the framework was corroborated through quantitative content and correspondence analysis. Thus, the answer to the second research question was given in Chapter Five.

The third research question was: according to experts, does the Green IS framework successfully capture the essential Green IS concepts and interrelationships to be relevant for environmental sustainability? This question was answered in Chapter Six by verifying the framework and proving its relevance using the focus group method and member checking. Additionally, member checking proved the framework's credibility. The result is a verified empirical management framework that explicates the enabling capabilities of Green IS, depicted as the finalised Green IS framework at the end of Chapter Six.

In order to address the research problem formulated in Chapter One, the main objective of this research was to develop an empirical Green IS framework that explicates the enabling and transforming capabilities of Green IS for environmental sustainability. This main objective was divided into two sub-objectives. The first sub-objective was to develop the Green IS framework using the grounded theory method and content and correspondence analysis, and the second sub-objective was to verify the developed Green IS framework using the focus group method and

member checking. The aforementioned answers to the research questions have led to the achievement of both these research sub-objectives and subsequently, the main research objective.

7.6 Research problem addressed

Prior research exposes how IS have significantly enabled and transformed organisations in many important ways (Watson, Boudreau, & Chen, 2010; Tambe & Hitt, 2012; Pitt *et al.*, 2011; Kuo, 2010; Mithas *et al.*, 2011; Besson & Rowe, 2012). However, it does not explicate the enabling and transforming capabilities of Green IS for environmental sustainability; this was the research problem.

The thesis has addressed this research problem by developing and verifying a Green IS framework that explicates the enabling capability of Green IS for environmental sustainability. Notably, the data provides evidence of the absence of the transforming capability of Green IS.

The research objective has been achieved and all the research questions answered. Firstly, the concept of environmental sustainability, in particular, strong environmental sustainability and its importance was elucidated, and it was contrasted with other contemporary, comparative concepts in the literature. Secondly, the enabling capability of Green IS for environmental sustainability was explicated in the form of the Green IS framework, exposing its manifestations and associated interrelationships. Thereafter, the Green IS framework was verified, proving its relevance and credibility. This explication of the key theoretical concepts and their interrelationships is an original contribution to the academic body of knowledge.

7.7 Management guidelines and recommendations

7.7.1 Overview

Addressing environmental resource depletion and degradation is a permanent business reality for organisations; it is a challenge and an opportunity (Hoffman & Woody, 2008). The Green IS framework developed in this research depicts how IS can be leveraged to further environmental sustainability. The framework highlights the enabling capabilities of Green IS that facilitate environmental sustainability, both within the banking organisations and in other varied organisations throughout the economy through their business interactions with the banking organisations. The framework also emphasises three key concepts that moderate how the enabling capabilities of Green IS facilitate environmental sustainability. Attention to these three moderating concepts is vital for furthering environmental sustainability, and the framework provides management with a handle on these vital concepts.

7.7.2 Achievement of strong environmental sustainability

Importantly, the framework is grounded in current business practices reflecting the achievement of a weak form of environmental sustainability, which promotes current business practices or small, incremental changes with persistent environmental resource depletion and degradation. This environmental resource depletion and degradation can only be addressed completely through strong environmental sustainability, and in this regard, the framework indicates that the same enabling capabilities of Green IS can be leveraged for strong environmental sustainability. This is evident where strong environmental sustainability is apparent in the data.

The framework is key for strong environmental sustainability as follows: The enabling capabilities of Green IS relate directly to business process efficiencies for reducing consumption and waste; carbon (and ecological) footprint management for controlling carbon waste emissions, water consumption, and other waste emissions; environmental data management for gathering and measuring environmental impacts; environmental analysis for understanding the organisational-environmental interaction and making effective environmental decisions; environmental information disclosure for communicating, creating shared understanding, and making effective decisions about the organisational-environmental interaction; and environmental risk management for identification, assessment, control, and mitigation of environmental events that may negatively affect the organisation. The Green IS framework depicts these salient management focal points.

In addition, the three key moderating concepts are vital for achieving strong environmental sustainability. Measuring and managing the consumption of non-renewables, renewables, and the emission of wastes requires that the related information be part of the organisation's business processes, that is Green IS integration. It also requires that the environmental data be accurate, reliable, consistent, accessible, and complete, that is environmental data quality, and that there be financial quantification, that is environmental-financial translation.

7.7.3 Implications for strategy and policy development

The intended users of the framework are senior sustainability management in banking organisations. Although they are not responsible for the IS function within the bank, they drive the environmental sustainability processes and projects and have influence in the corresponding budgets. Furthermore, these managers have a deep understanding of the environmental sustainability data, processes, analyses, reporting, foot printing, and risk management, including the associated opportunities and challenges. As such, they are ideally placed to assess how well their environmental sustainability management functions are being enabled by the organisation's IS and subsequently to affect any related IS change initiatives.

The framework is an essential input into this management level's environmental sustainability models. It helps management to understand the mechanism by which strategic environmental sustainability transformation is enabled or not by IS. The framework supports management in achieving their current environmental strategy and in informing future environmental strategy by facilitating the required environmental information and management functions. The framework informs organisational IS and environmental sustainability policy development by highlighting the need for improved Green IS integration, environmental data quality, and environmental-financial translation. Furthermore, it guides organisational IS and environmental sustainability policy development in terms of the required Green IS enabled management functions needed to progress environmental sustainability transformation. Subsequently, the framework guides the allocation of organisational resources, being human, financial, and technological resources, for implementing the required Green IS enabled management functions for environmental sustainability transformation.

7.7.4 Practical guidelines for management

Subsection 7.7.4 presents practical guidelines for management, derived from the Green IS framework.

1. Integrate Green IS into organisational systems and processes. The data demonstrates that a lack of integration of Green IS into organisational systems and processes facilitates the exclusion of environmental considerations, which negatively affects environmental sustainability. For example, Green IS integration into the credit granting processes ensures that environmental diligence cannot be circumvented; Green IS integration into investment decision-making ensures that environmental considerations are included as investment criteria; and Green IS integration into organisational communication systems such as intranet portals ensures shared understanding and co-ordinated achievement of environmental goals.
2. Obtain and produce accurate, reliable, consistent, accessible, and complete environmental data. Environmental data is significantly different from the financial and transactional data historically managed by banking organisations. The research data shows that poor environmental data quality hinders environmental management and produces inaccurate environmental reporting, inaccurate baselines and targets, poor environmental decision-making, and ineffective environmental performance. Notably, there is an increased monetary and time cost as the quality of environmental data is increased. Thus, management must determine the point where the environmental data quality is good enough, within the organisation's financial and time constraints, for the achievement of the environmental goals. The risks, financial and otherwise, of poor data quality should be included in this assessment.

3. Translate environmental interactions into financial values. The data shows that environmental sustainability is managed and controlled by measuring its financial or economic value. Without environmental-financial translation, sustainability cannot be managed or controlled and this has a material effect on any environmental sustainability transformation. In particular, top management and decision committees require monetary values together with non-monetary quantitative and qualitative information in order to make decisions; this is to ensure that there are sufficient financial resources to implement any changes.
4. Implement IS enabled business process efficiencies. Any business process efficiencies enabled by IS potentially have a positive effect on an organisation's environmental sustainability. The explicit purpose of the IS that enable business process efficiencies is usually cost reduction, instead of environmental sustainability. Nevertheless, the result is that organisational processes become more efficient resulting in reduced resource usage and/or reduced waste, which translates into improved environmental sustainability. For example, IS-enabled automation of paper-based processes results in decreased environmental resource use and waste and improved environmental sustainability.
5. Allocate Green IS resources to environmental data management. This Green IS enabled management function relates to the moderating concept of environmental data quality. Green IS enabled environmental data management is the starting point for accurate, reliable, consistent, accessible, and complete environmental data. These Green IS are designed to enable the management of an organisation's environmental data, such as kilowatt-hours, which are significantly different from an organisation's financial and transactional data. In addition, they address environmental data particulars such as centralised access to geographically dispersed data, environmental data audit trails and external data verification, the allocation of specific people to and/or responsibility for obtaining environmental data, and the large volumes of environmental data.
6. Utilise Green IS enabled environmental analysis. Green IS, such as environmental dashboards, enable the examination of the effect of business activities on the environment and expose meaningful patterns. These Green IS support decision-making about an organisation's direct and indirect environmental impact. In addition, they uncover trends and reduction opportunities and enable comparisons from year to year or to a baseline year, future projections, and visualisation of environmental impacts. These analyses are vital for environmental sustainability.
7. Promote environmental information disclosure. Green IS enable the disclosure of an organisation's environmental information. These Green IS enable environmental information

to be disclosed appropriately, for example with specifically designed reports or even product carbon footprint details on mobile phones, to each type of stakeholder, such as management, clients, investors, or government. These Green IS directly address many of the environmental sustainability transformation drivers. Furthermore, they enable an informed environmental strategy, create environmental awareness right up to top management, and are key for environmental communication throughout an organisation.

8. Conduct carbon (and ecological) footprint management. The Green IS that enable the management of GHG emissions are central to the banks' primary direct environmental impact. These emissions relate mainly to energy usage in the banks. Thus, there is a visible and related financial cost benefit for reductions in energy usage or emissions. In addition, these Green IS enable carbon performance management, electricity usage management, and enterprise carbon accounting. To a far lesser extent in the banks, and possibly a far greater extent in other non-financial organisations, are the other ecological footprint management items of water and non-GHG waste emissions. Green IS similarly enable the management of these items, for example, an organisation's important water resources, which are very constrained in South Africa, and other waste such as waste from production processes.
9. Manage environmental risks. There are many and significant risks to banks arising from the environmental impact of activities that they finance throughout the economy. Examples are credit risk due to the inability of borrowers to repay loans as a result of environmental damage stopping production, excessive fines, environmental taxation or legislation, and reputational risks that impact share price and investment. Green IS enable the management of these risks, so that the organisation's assets and performance are protected.
10. Use the framework as a cross-departmental and leadership communication tool. The framework is for use by senior sustainability management as a tool for facilitating understanding and subsequent effective action relating to Green IS for environmental sustainability. The framework, with its contextual elaboration yet parsimonious structure, promotes shared understanding of the salient aspects and subsequent co-operation for environmental sustainability. Importantly, in terms of leadership decision-making, the framework provides leadership with the key components and their relationships from which to determine optimal courses of action and optimal allocation of human, financial, and technological resources.

7.8 Value for academics

This research is an original contribution to the IS academic body of knowledge, as it explicates the enabling capability of Green IS in the form of the Green IS framework. This is a significant

response to the academic calls for elaborating on and exposing Green IS constructs in a research domain with nascent theory, especially the capabilities of IS for environmental sustainability. The Green IS framework explicates the salient Green IS concepts and their interrelationships, explaining what the concepts are, how they are related, why they are related, and when, for whom, and where these concepts and interrelationships manifest. In addition, this research is an original contribution to transdisciplinary research involving IS, organisations, and environmental sustainability.

The Green IS framework functions as a descriptive framework through its parsimony comprising 11 key concepts, domain-coverage, and internal consistency, as a normative or prescriptive framework by guiding and informing management practice, and as an analytical or empirical framework by directing further empirical research (Bensaou & Venkatraman, 1996). The framework exposes the key theoretical concepts and their interrelationships to guide further academic debate, analysis, and research in the domain of Green IS.

Furthermore, the research contributes by exposing banking organisations as control points for influencing environmental performance extensively in the economy and by expounding the concept of strong environmental sustainability as it relates to IS. Notably, the Green IS framework, while grounded in current business practices that reflect the achievement of a weak form of environmental sustainability, also explicates the same enabling capability of Green IS for strong environmental sustainability.

From a methodological perspective, the research provides research design insights by detailing the design choices and rationale. The research exposes how qualitative research is enhanced by quantitative research, and vice versa. Such enhancement mitigates the problem of inherent bias that exists in any one particular approach, mitigates the limitations of a single research approach, benefits from different epistemological perspectives, has greater applicability to complex organisational contexts, and makes a more significant contribution to scholarly and practical knowledge. In addition, the research exposes an appropriate assessment of rigour for the promotion of rigour in future IS research.

7.9 Limitations and future research

Environmental sustainability is a complex research domain involving potentially every human activity. This research focused, as justified in Chapter One, on a particular and important aspect of environmental sustainability, namely IS within South African banking organisations. Such a focus can be considered a limitation in terms of a broader perspective, which involves a wide variety of industries and organisations, and even individuals, interacting in many different ways

with the environment. However, this focus was justified in Chapter One and makes an important and original contribution to a research domain with nascent theory.

Nonetheless, there are numerous future research opportunities. In addition to South African banks, many international banks via their South African branches influence the South African economy and these potentially provide opportunities for new data to enhance and extend the Green IS framework, both locally and internationally. Additionally, the overall South African financial services sector, not just banking, may potentially provide new data for extending the Green IS framework.

Another avenue for research is extending the Green IS framework to organisations in other industries, apart from financial services. Such extensions will raise the theoretical abstraction of the framework as well as its relevance and usefulness in widespread practice. Given that the framework was grounded in data from the South African banking industry, it is expected that data from another industry will necessitate changes to the framework's concepts and their interrelationships, to reflect that industry's specific interactions with the environment. For example, a manufacturing organisation may have a large supply chain involving physical products and not be involved in financing. At the very least, this suggests adapting the financing aspect of the framework for the supply chain aspect.

In terms of environmental sustainability, the concept of strong environmental sustainability was not prevalent in the researched organisations even though it was justified as being critical. In addition, no IS literature was found that pertains to what the environment can sustain in relation to what is consumed and emitted by an organisation; this refers to strong environmental sustainability at an organisational level. Thus, addressing strong environmental sustainability at an organisational level presents important research opportunities that potentially involve extensive interconnected IS with environmental sensors.

Environmental problems such as climate change are becoming worse and the consequences progressively severe. IS are vital for the mitigation of and adaption to these negative changes in the environment and given the nascent stage of IS research in this domain coupled with the vast extent of the problem, the opportunities are abundant for IS researchers to apply IS research to these problems. The preceding paragraphs in this section present just a few of the many important and necessary research opportunities in this domain.

7.10 Chapter summary and conclusions

Chapter Seven contained the overall research conclusions based on all the preceding chapters in the research. The objectives of the chapter have been met because it has been proved that the research problem has been addressed, in subsections 7.2, 7.3, 7.4, and 7.6, the research questions

have been answered, in subsections 7.2, 7.3, 7.4, and 7.5, and the research objective has been achieved, in subsections 7.2, 7.3, 7.4, and 7.5. Management guidelines and recommendations for environmental sustainability were provided in subsection 7.7 and the value of the research for academics was explained in subsections 7.8 and 7.9. Thus, the goal of Chapter Seven has been achieved, which was to present the outcomes or conclusions of the research.

In conclusion, the research has addressed a significant research problem, which was expounded and justified in Chapter One. Thus, the outcome is an original contribution to the academic body of knowledge, exhibiting both relevance and rigour, as detailed in Chapter Six. The research has addressed the research problem by achieving the research objective of developing and verifying an empirical Green IS framework that explicates the enabling and transforming capabilities of Green IS for environmental sustainability. Notably, the data shows the absence of any transforming capability of Green IS, as detailed in subsection 7.4. In addition, the research questions have been answered. Specifically, research question 1 was answered in Chapter Two, research question 2 was answered by Chapters Four and Five, and research question 3 in Chapter Six.

This chapter has value for academics because it presents, concisely, the significant and original response of the research to the academic calls for elaborating on and exposing Green IS constructs in a research domain with nascent theory, especially the capabilities of IS for environmental sustainability. The chapter summarised the methodology, which provided research design insights by exposing how qualitative research can be enhanced by quantitative research, and vice versa. In addition, the chapter reiterated the assessment of rigour for the promotion of rigour in future comparable research. Additionally, this chapter has substantial value for industry and organisations as it provided management guidelines and recommendations, based on the verified Green IS framework, for furthering environmental sustainability. These management guidelines and recommendations related to the achievement of both weak and strong environmental sustainability, identified the implications for environmental strategy and policy development, and presented the corresponding practical guidelines for management.

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Annexure A: Concept-Centric Literature Matrix

	Identifier		1	2	3	4	5
#	Concepts / Author/s, Year, Publication	Total per reference	Environmental Sustainability	Enabling and Transforming IS	Organisational Environmental strategy and management	Green Information Systems (IS)	Green IS and Related Frameworks
	Total per concept						
1.	Fairweather (2011) - Journal of Information, Communication and Ethics in Society (Journal)		X			X	
2.	Elliot (2011) – MIS Quarterly (Journal)		X	X			X
3.	Jenkin *et al.* (2011) - Information and Organization (Journal)		X			X	X
4.	Glavic & Lukman (2007) - Journal of Cleaner Production (Journal)		X			X	
5.	Banerjee (2003) - Organization Studies (Journal)		X			X	
6.	Orimoogunje *et al.* (2011) - Ife PsychologIA (Journal)		X				
7.	Laszlo & Laugel (2000) - Large-scale organizational change (Book)		X				
8.	Elliot (2007) – 11th Pacific Asia Conference on Information Systems (PACIS)		X				
9.	Verheul & Vergragt (1995) - Technology Analysis & Strategic Management (Journal)		X				
10.	Hovorka *et al.* (2012) - Green business process management: Towards the sustainable enterprise (Book)		X				
11.	Böhringer & Jochem (2007) - Ecological Economics (Journal)		X				
12.	Dietz & Neumayer (2007)- Ecological Economics (Journal)		X				
13.	Kemp & Soete (1992) – Futures (Journal)		X				
14.	Bartlett (1994) - Population & Environment (Journal)		X				
15.	Goodland (1995) - Annual Review of Ecology and Systematics (Journal)		X				
16.	Zhao *et al.* (2009) - The International Journal of Sustainable Development & World Ecology (Journal)		X				
17.	Costanza *et al.* (1997) – Nature (Journal)		X				
18.	Sowman & Brown (2006) - Journal of Environmental Planning and Management (Journal)		X				
19.	Milne *et al.* (2006) – Organization (Journal)		X				
20.	Laine (2010) - European Accounting Review (Journal)		X				
21.	Dernbach (2003) - Indiana Journal of Global Legal Studies (Journal)		X				
22.	Hanson (2000) - Journal of the Community Development Society (Journal)		X				
23.	Ekins *et al.* (2003) - Ecological Economics (Journal)		X				
24.	Diedrich *et al.* (2011) - Environmental Science & Policy (Journal)		X				
25.	Manzini *et al.* (2011) - Technological Forecasting and Social Change (Journal)		X				
26.	Daily & Ehrlich (1992) – Bioscience (Journal)		X				
27.	Ehrlich & Holdren (1971) – Science (Journal)		X				
28.	Goodland & Daly (1996) - Ecological Applications (Journal)		X				
29.	Goodland *et al.* (1994) – Futures (Journal)		X				
30.	Cairns Jr. (1997) - Environmental Health Perspectives (Journal)		X				
31.	Parris & Kates (2003) - Annual Review of Environment and Resources (Journal)		X				
32.	DesAutels & Berthon (2011) - The Journal of Strategic Information Systems (Journal)		X				

Annexure A: Concept-Centric Literature Matrix

#	Identifier / Concepts / Author/s, Year, Publication	Total per reference	1 Environmental Sustainability	2 Enabling and Transforming IS	3 Organisational Environmental strategy and management	4 Green Information Systems (IS)	5 Green IS and Related Frameworks
	Total per concept						
33.	Brundtland Commission (1987) - United Nations World Commission on Environment and Development (Report)		X				
34.	Krajnc & Glavic (2005) - Resources, Conservation and Recycling (Journal)		X				
35.	Dean & McMullen (2007) - Journal of Business Venturing (Journal)		X				
36.	Bose & Luo (2011) - The Journal of Strategic Information Systems (Journal)			X			X
37.	Dao *et al.* (2011) - The Journal of Strategic Information Systems (Journal)			X		X	X
38.	Pitt *et al.* (2011) - The Journal of Strategic Information Systems (Journal)			X		X	
39.	Watson, Boudreau, & Chen (2010) – MIS Quarterly (Journal)			X		X	X
40.	Melville (2010) – MIS Quarterly (Journal)			X			X
41.	Melville *et al.* (2004) - MIS Quarterly (Journal)			X			
42.	Watson & Straub (2007) - ACM SIGMIS Database: The DATA BASE for Advances in Information Systems (Journal)			X			
43.	Bensaou & Venkatraman (1996) - European Journal of Information Systems (Journal)			X			
44.	Basahel & Irani (2010) - 7th European, Mediterranean & Middle Eastern Conference on Information Systems (EMCIS)			X			
45.	Mithas *et al.* (2011) - MIS Quarterly (Journal)			X			
46.	Lee *et al.* (2011) - Information & Management (Journal)			X			
47.	Tambe & Hitt (2012) - Information Systems Research (Journal)			X			
48.	Xue *et al.* (2012) - MIS Quarterly (Journal)			X			
49.	Cheng & Nault (2012) - Information Systems Research (Journal)			X			
50.	Han *et al.* (2011) - Journal of Management Information Systems (Journal)			X			
51.	Chen (2012) - Information & Management (Journal)			X			
52.	Aral *et al.* (2012) - Information Systems Research (Journal)			X			
53.	Wong *et al.* (2011) - Journal of Management Information Systems (Journal)			X			
54.	Wang *et al.* (2012) - Journal of Management Information Systems (Journal)			X			
55.	Kim *et al.* (2011) - Journal of the Association for Information Systems (Journal)			X			
56.	Rai *et al.* (2012) - MIS Quarterly (Journal)			X			
57.	Roberts *et al.* (2012) - MIS Quarterly (Journal)			X			
58.	Kane & Borgatti (2011) - MIS Quarterly (Journal)			X			
59.	Tambe *et al.* (2012) - Management Science (Journal)			X			
60.	Tallon & Pinsonneault (2011) - MIS Quarterly (Journal)			X			
61.	Nevo & Wade (2011) - Journal of Strategic Information Systems (Journal)			X			
62.	Sako (2012) - Communications of the ACM (Journal)			X			
63.	Lau *et al.* (2012) - MIS Quarterly (Journal)			X			
64.	Leidner *et al.* (2011) - Journal of Strategic Information Systems (Journal)			X			
65.	Dewan & Ren (2011) - Information Systems Research (Journal)			X			
66.	McLaren *et al.* (2011) - MIS Quarterly (Journal)			X			

Annexure A: Concept-Centric Literature Matrix

#	Identifier: Concepts / Author/s, Year, Publication	Total per reference	1 Environmental Sustainability	2 Enabling and Transforming IS	3 Organisational Environmental strategy and management	4 Green Information Systems (IS)	5 Green IS and Related Frameworks
	Total per concept						
67.	Roberts & Grover (2012) - Journal of Management Information Systems (Journal)			X			
68.	Mithas *et al.* (2012) - MIS Quarterly (Journal)			X			
69.	Han *et al.* (2012) - MIS Quarterly (Journal)			X			
70.	Carlo *et al.* (2011) - Information Systems Journal (Journal)			X			
71.	Kleis *et al.* (2012) - Information Systems Research (Journal)			X			
72.	Besson & Rowe (2012) - Journal of Strategic Information Systems (Journal)			X			
73.	Orlikowski (2000) - Organization Science (Journal)			X			
74.	Lu & Ramamurthy (2011) - MIS Quarterly (Journal)			X			
75.	DeSanctis & Poole (1994) - Organization Science (Journal)			X			
76.	O'Donnell & David (2000) - International Journal of Accounting Information Systems (Journal)			X			
77.	Kettinger *et al.* (1994) - MIS Quarterly (Journal)			X			
78.	Hedman & Kalling (2003) - European Journal of Information Systems (Journal)			X			
79.	King *et al.* (1994) - Information Systems Research (Journal)			X			
80.	DiMaggio & Powell (1983) - American Sociological Review (Journal)			X			
81.	Glazer (1993) - IBM Systems Journal (Journal)			X			
82.	Walsham & Sahay (2006) - Information Technology for Development (Journal)			X			
83.	Leonardi (2007) - Organization Science (Journal)			X			
84.	Orlikowski & Robey (1991) - Information Systems Research (Journal)			X			
85.	Hevner *et al.* (2004) - MIS Quarterly (Journal)			X			
86.	Tushman & Nadler (1978) - Academy of Management Review (Journal)			X			
87.	Yates & van Maanen (1996) - Information Systems Research (Journal)			X			
88.	Orlikowski (1996) - Information Systems Research (Journal)			X			
89.	Robey & Sahay (1996) - Information Systems Research (Journal)			X			
90.	Manning (1996) - Information Systems Research (Journal)			X			
91.	Robey & Boudreau (1999) - Information Systems Research (Journal)			X			
92.	Barrett & Walsham (1999) - Information Systems Research (Journal)			X			
93.	O'Leary & Turban (1987) - Human Systems Management (Journal)			X			
94.	Porter (1985) - Journal of Business Strategy (Journal)			X			
95.	Gurbaxani & Whang (1991) - Communications of the ACM (Journal)			X			
96.	Yip (2000) - Business Strategy Review (Journal)			X			
97.	Winter & Taylor (1996) - Information Systems Research (Journal)			X			
98.	Straub & Watson (2001) - Information Systems Research (Journal)			X			
99.	Peppard (2008) - Construction Innovation: Information, Process, Management (Journal)			X			
100.	Moreton (1995) - Journal of Strategic Information Systems (Journal)			X			
101.	Lucas & Grover (2008) - Communications of the Association for Information Systems (Journal)			X			

Annexure A: Concept-Centric Literature Matrix

#	Identifier: Concepts / Author/s, Year, Publication	Total per reference	1 Environmental Sustainability	2 Enabling and Transforming IS	3 Organisational Environmental strategy and management	4 Green Information Systems (IS)	5 Green IS and Related Frameworks
	Total per concept						
102.	Zmud *et al.* (1986) - ACM SIGMIS Database (Journal)			X			
103.	Avgerou (2008) - Journal of Information Technology (Journal)			X			
104.	Johnston & Vitale (1988) - MIS Quarterly (Journal)			X			
105.	Agarwal & Lucas Jr (2005) - MIS Quarterly (Journal)			X			
106.	Moody & Walsh (1999) - 7th European Conference on Information Systems (ECIS)			X			
107.	Kuruzovich (2009) - 15th Americas Conference on Information Systems (AMCIS)			X			
108.	Grover & Kohli (2012) - MIS Quarterly (Journal)			X			
109.	Avital *et al.* (2007) - Communications of the Association for Information Systems (Journal)			X			
110.	Alter (2008) - European Journal of Information Systems (Journal)			X			
111.	Elliot (2006) - Industry and Innovation (Journal)			X			
112.	Orlikowski & Iacono (2001) - Information Systems Research (Journal)			X			
113.	Chow & Chen (2012)- Journal of Business Ethics (Journal)				X	X	
114.	Shrivastava & Hart (1994) - The International Journal of Public Administration (Journal)				X	X	
115.	Harmon & Demirkan (2011a) - 2011 Annual SRII Global Conference (SRII)				X	X	
116.	Mbohwa & Agwa-Ejon (2011) - The Journal for Transdisciplinary Research in Southern Africa (Journal)				X	X	
117.	Bleischwitz (2003) - Ecological Economics (Journal)				X		
118.	Simula *et al.* (2009) - Journal of Systems and Information Technology (Journal)				X		
119.	Chang *et al.* (2011) - 15th Pacific Asia Conference on Information Systems (PACIS)				X		
120.	Darnall & Edwards Jr (2006) - Strategic Management Journal (Journal)				X		
121.	Pulver (2007) - Studies in Comparative International Development (SCID) (Journal)				X		
122.	Zhang (2011) - Climate Policy (Journal)				X		
123.	Dyllick & Hockerts (2002) - Business Strategy and the Environment (Journal)				X		
124.	Zhu *et al.* (2008) - Transportation Research Part E: Logistics and Transportation Review (Journal)				X		
125.	Doh & Guay (2006) - Journal of Management Studies (Journal)				X		
126.	Zhu & Sarkis (2007) - International Journal of Production Research (Journal)				X		
127.	Delmas & Toffel (2004) - Business Strategy and the Environment (Journal)				X		
128.	Siegel (2009) - The Academy of Management Perspectives (Journal)				X		
129.	Shrivastava (1995) - Academy of Management Review (Journal)				X		
130.	Bansal & Roth (2000) - Academy of Management Journal (Journal)				X		
131.	Senge *et al.* (2001) - MIT Sloan Management Review (Journal)				X		
132.	Marcus *et al.* (2010) - Business & Society (Journal)				X		

Annexure A: Concept-Centric Literature Matrix

#	Identifier / Concepts / Author/s, Year, Publication	Total per reference	1 Environmental Sustainability	2 Enabling and Transforming IS	3 Organisational Environmental strategy and management	4 Green Information Systems (IS)	5 Green IS and Related Frameworks
	Total per concept						
133.	Hart & Dowell (2011) - Journal of Management (Journal)				X		
134.	de Villiers *et al.* (2011) - Journal of Management (Journal)				X		
135.	Etzion (2007) - Journal of Management (Journal)				X		
136.	Hart (1995) - The Academy of Management Review (Journal)				X		
137.	Padma *et al.* (2008) - Benchmarking: An International Journal (Journal)				X		
138.	Hu & Bidanda (2009) - International Journal of Production Economics (Journal)				X		
139.	Tzschentke *et al.* (2008) - Service Industries Journal (Journal)				X		
140.	Vormedal (2008) - Global Environmental Politics (Journal)				X		
141.	Machiba (2010) - International Economics and Economic Policy (Journal)				X		
142.	Babcock (2009) - Harvard Environmental Law Review (Journal)				X		
143.	Fortes (2002) - Greener Management International (Journal)				X		
144.	Lewis & Stewart (2003) - Systems Research and Behavioral Science (Journal)				X		
145.	Gonzalez-Benito & Gonzalez-Benito (2005) – Omega (Journal)				X		
146.	Ellison *et al.* (2005) - The Journal of Corporate Citizenship (Journal)				X		
147.	Cordeiro *et al.* (2008) – Omega (Journal)				X		
148.	Carter *et al.* (2009) - Journal of Supply Chain Management (Journal)				X		
149.	Michalisin & Stinchfield (2010) - Journal of Business Strategies (Journal)				X		
150.	Clarke & O'Neill (2005) - Greener Management International (Journal)				X		
151.	Smith & Perks (2010) - Southern African Business Review (Journal)				X		
152.	Walker *et al.* (2007) - Journal of Facilities Management (Journal)				X		
153.	Pérez *et al.* (2007) - Accounting, Auditing & Accountability Journal (Journal)				X		
154.	Wilmshurst & Frost (2001) - Business Strategy and the Environment (Journal)				X		
155.	Roy *et al.* (2001) - Business Strategy and the Environment (Journal)				X		
156.	Bamber *et al.* (2002) - Managerial Auditing Journal (Journal)				X		
157.	von Malmborg (2002) - Business Strategy and the Environment (Journal)				X		
158.	Tinsley (2002) - Business Strategy and the Environment (Journal)				X		
159.	Halkos & Evangelinos (2002) - Business Strategy and the Environment (Journal)				X		
160.	Jennings & Zandbergen (1995) - Academy of Management Review (Journal)				X		
161.	Mercier & McGowan (1996) - Administration & Society (Journal)				X		
162.	Polonsky *et al.* (1998) - Asia Pacific Journal of Marketing and Logistics (Journal)				X		
163.	Green *et al.* (2000) - Organization & Environment (Journal)				X		
164.	Harris & Crane (2002) - Journal of Organizational Change Management (Journal)				X		
165.	Morhardt *et al.* (2002) - Corporate Social - Responsibility and Environmental Management (Journal)				X		
166.	Hervani *et al.* (2005) – Benchmarking (Journal)				X		

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#	Identifier: Concepts / Author/s, Year, Publication	Total per reference	1 Environmental Sustainability	2 Enabling and Transforming IS	3 Organisational Environmental strategy and management	4 Green Information Systems (IS)	5 Green IS and Related Frameworks
	Total per concept						
167.	Bansal (2005) - Strategic Management Journal (Journal)				X		
168.	Hemingway & Maclagan (2004) - Journal of Business Ethics (Journal)				X		
169.	Gago & Antolin (2004) - Business Strategy and the Environment (Journal)				X		
170.	Rivera-Camino (2007) - European Journal of Marketing (Journal)				X		
171.	Perkins (2007) - Studies in Comparative International Development (Journal)				X		
172.	Salmi (2008) - International Environmental Agreements: Politics, Law and Economics (Journal)				X		
173.	López-Gamero *et al.* (2008) - Journal of Business Ethics (Journal)				X		
174.	Atasu *et al.* (2009) - Production and Operations Management (Journal)				X		
175.	Kanarattanavong & Ruenrom (2009) - The Business Review, Cambridge (Joutnal)				X		
176.	Reverte (2009) - Journal of Business Ethics (Journal)				X		
177.	Dwyer (2009) - Management Decision (Journal)				X		
178.	Pane Haden *et al.* (2009) - Management Decision (Journal)				X		
179.	Herremans *et al.* (2009) - Journal of Business Ethics (Journal)				X		
180.	Branzei *et al.* (2004) - Strategic Management Journal (Journal)				X		
181.	Carroll (1991) - Business Horizons (Journal)				X		
182.	Cordano *et al.* (2010) - Journal of Business Ethics (Journal)				X		
183.	Dangelico & Pujari (2010) - Journal of Business Ethics (Journal)				X		
184.	D'Souza *et al.* (2007) - Journal of Targeting, Measurement and Analysis for Marketing (Journal)				X		
185.	Hendry & Vesilind (2005) - Clean Technologies and Environmental Policy (Journal)				X		
186.	Hu & Hsu (2010) - Management Research Review (Journal)				X		
187.	Rao & Holt (2005) - International Journal of Operations & Production Management (Journal)				X		
188.	Sen *et al.* (2006) - Journal of the Academy of Marketing Science (Journal)				X		
189.	Lin & Ho (2011) - Journal of Business Ethics (Journal)				X		
190.	Özen & Küskü (2009) - Journal of Business Ethics (Journal)				X		
191.	Hoffman (2010) - Organizational Dynamics (Journal)				X		
192.	Berkhout *et al.* (2006) - Climatic Change (Journal)				X		
193.	Nishant *et al.* (2011) - 15th Pacific Asia Conference on Information Systems (PACIS)				X		
194.	Davidson & Wilson (2006) - Social Change in the 21st Century Conference				X		
195.	Bergmiller & McCright (2009) - Institute of Industrial Engineers IIE) Annual Conference				X		
196.	Cai *et al.* (2008) - 4th IEEE International Conference on Management of Innovation and Technology (ICMIT)				X		
197.	Renwick *et al.* (2012) - International Journal of Management Reviews (Journal)				X		
198.	Nowak *et al.* (2011) - Information and Communication on Technology for the Fight Against Global Warming				X		

Annexure A: Concept-Centric Literature Matrix

	Identifier		1	2	3	4	5
#	Concepts / Author/s, Year, Publication	Total per reference	Environmental Sustainability	Enabling and Transforming IS	Organisational Environmental strategy and management	Green Information Systems (IS)	Green IS and Related Frameworks
	Total per concept						
199.	Bergin-Seers & Mair (2009) - Tourism and Hospitality Research (Journal)				X		
200.	Suplico (2009) - Journal of International Business Research (Journal)				X		
201.	Oates *et al.* (2008) - Journal of Marketing Communications (Journal)				X		
202.	Young *et al.* (2010) - Sustainable Development (Journal)				X		
203.	Alfredsson (2004) – Energy (Journal)				X		
204.	Ryoo *et al.* (2011) - 17th Americas Conference on Information Systems (AMCIS)				X		
205.	Berthon *et al.* (2011) - The oxford handbook of management information systems: Critical perspectives and new directions (Book)				X	X	
206.	Aarabi *et al.* (2011) - IEEE International Conference on Industrial Engineering and Engineering Management (IEEM)				X	X	
207.	Dwyer & Hasan (2012) - The International Journal of Social and Organizational Dynamics in Information Technology (Journal)– possible duplicate of Hasan & Dwyer (2010) - 16th Americas Conference on Information Systems (AMCIS)			X		X	
208.	Fuchs (2008) - Environment, Development and Sustainability (Journal)		X			X	
209.	Daly (2006) - The future of sustainability (Book)					X	
210.	Chen, Watson, Boudreau, & Karahanna (2010) - Australasian Journal of Information Systems (Journal)– possible duplicate of Chen, Watson, Boudreau, & Karahanna (2009) - 30th International Conference on Information Systems (ICIS)					X	
211.	Chen *et al.* (2008) - Journal of Systems and Information Technology (Journal)					X	
212.	Corbett *et al.* (2011) - SIGGreen Workshop. Sprouts: Working Papers on Information Systems					X	
213.	Moldan *et al.* (2011) - Ecological Indicators (Journal)					X	
214.	Dewulf & Van Langenhove (2005) - Resources, Conservation and Recycling (Journal)					X	
215.	Benitez-Amado & Walczuch (2011) - 17th Americas Conference on Information Systems (AMCIS)					X	
216.	Holmström *et al.* (2010) - Industrial informatics design, use and innovation: Perspectives and services (Book)					X	
217.	Watson *et al.* (2012) - Communications of the ACM (Journal)					X	
218.	Watson, Boudreau, Li, & Levis (2010) - MIS Quarterly Executive (Journal)					X	
219.	Berthon & Donnellan (2011) - The Journal of Strategic Information Systems (Journal)					X	
220.	Erek (2011) - 8th European, Mediterranean & Middle Eastern Conference on Information Systems (EMCIS)					X	
221.	Hilty *et al.* (2006) - Environmental Modelling & Software (Journal)					X	
222.	van Osch & Avital (2011) - Governance and Sustainability in Information Systems. Managing the Transfer and Diffusion of IT (Book)					X	
223.	Green Jr, Zelbst, Meacham, & Bhadauria (2012) - Supply Chain Management: An International Journal (Journal)					X	

Annexure A: Concept-Centric Literature Matrix

#	Identifier: Concepts / Author/s, Year, Publication	Total per reference	1 Environmental Sustainability	2 Enabling and Transforming IS	3 Organisational Environmental strategy and management	4 Green Information Systems (IS)	5 Green IS and Related Frameworks
	Total per concept						
224.	Ijab (2011) - SIGGreen Workshop. Sprouts: Working Papers on Information Systems					X	
225.	Watson, Boudreau, Chen, & Sepúlveda (2011) - The Journal of Strategic Information Systems (Journal)					X	
226.	Molla, Pittayachawan, Corbitt, & Deng (2009) - International Journal of e-Business Management (Journal)					X	
227.	Malmodin *et al.* (2010) - Journal of Industrial Ecology: Special Issue: Environmental Applications of Information & Communication Technology (Journal)					X	
228.	Benitez-Amado, Perez-Arostegui, & Tamayo-Torres (2010) - The Journal of Computer Information Systems (Journal)					X	
229.	Huang (2009) - Journal of Computer Information Systems (Journal)					X	
230.	Achim *et al.* (2009) - International Journal of Strategic Management (Journal)					X	
231.	Seidel & Recker (2012) - 23rd Australasian Conference on Information Systems (ACIS)					X	
232.	Cserny *et al.* (2009) - Environmental Science and Pollution Research International (Journal)					X	
233.	Hedman & Henningsson (2011) - IT Professional Magazine (Journal)					X	
234.	Rahimifard *et al.* (2004) - Proceedings of the Institution of Mechanical Engineers (Journal)					X	
235.	Casal *et al.* (2005) - Foresight : The Journal of Futures Studies, Strategic Thinking and Policy (Journal)					X	
236.	Melnyk *et al.* (1999) - Production and Inventory Management Journal (Journal)					X	
237.	Loos *et al.* (2011) - Business and Information Systems Engineering (Journal)					X	
238.	Isenmann *et al.* (2011) - 44th Hawaii International Conference on System Sciences (HICSS)					X	
239.	Wati & Koo (2011) - 44th Hawaii International Conference on System Sciences (HICSS)					X	
240.	El-Gayar *et al.* (2011) - 44th Hawaii International Conference on System Sciences (HICSS)					X	
241.	Hilpert *et al.* (2011) - 44th Hawaii International Conference on System Sciences (HICSS)					X	
242.	Denzer *et al.* (2011) - 44th Hawaii International Conference on System Sciences (HICSS)					X	
243.	Todorov & Marinova (2010) - 43rd Hawaii International Conference on System Sciences (HICSS)					X	
244.	Curry *et al.* (2011) - 19th European Conference on Information Systems (ECIS)					X	
245.	Hjalmarsson & Lind (2011) - 19th European Conference on Information Systems (ECIS)					X	

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246.	Volkoff *et al.* (2011) - 17th Americas Conference on Information Systems (AMCIS)					X	
247.	Vazquez *et al.* (2011) - 17th Americas Conference on Information Systems (AMCIS)					X	
248.	Allenby *et al.* (2001) - Information systems and the environment (Book)					X	
249.	Rikhardsson (2001) - Eco - Management and Auditing (Journal)					X	
250.	Ijab *et al.* (2011) - 22nd Australasian Conference on Information Systems (ACIS)					X	
251.	Catulli & Fryer (2012) - Journal of Industrial Ecology (Journal)					X	
252.	Laitner (2002) - Journal of Industrial Ecology (Journal)					X	
253.	Sen *et al.* (2000) - Decision Support Systems (Journal)					X	
254.	Shaft *et al.* (2001) - Journal of Industrial Ecology (Journal)					X	
255.	Collard *et al.* (2005) - Energy Economics (Journal)					X	
256.	Kim *et al.* (2012) - Automation in Construction (Journal)					X	
257.	Ramchurn *et al.* (2011) - ACM Transactions on Intelligent Systems and Technology (Journal)					X	
258.	Ham *et al.* (2009) - 4th International Conference on Persuasive Technology					X	
259.	Kim, Hong, & Magerko (2010) - 8th ACM Conference on Designing Interactive Systems					X	
260.	Pierce *et al.* (2008) - 20th Australasian Conference on Computer-Human Interaction: Designing for Habitus and Habitat					X	
261.	Hay & Rice (2009) - 1st ACM Workshop on Embedded Sensing Systems for Energy-Efficiency in Buildings					X	
262.	Nguyen *et al.* (2010) - 12th International Conference on Information Integration and Web-Based Applications & Services					X	
263.	He *et al.* (2010) - 28th International Conference on Human Factors in Computing Systems					X	
264.	Zapico *et al.* (2009) - 4th International Conference on Persuasive Technology					X	
265.	Paulos & Pierce (2011) - 44th Hawaii International Conference on System Sciences (HICSS)					X	
266.	Benitez-Amado & Walczuch (2012) - European Journal of Information Systems (Journal)					X	X
267.	Bengtsson & Ågerfalk (2011) - The Journal of Strategic Information Systems (Journal)					X	X
268.	Zhang *et al.* (2011) - The Journal of Strategic Information Systems (Journal)					X	X
269.	El-Gayar & Fritz (2006) - Communications of the Association for Information Systems (Journal)					X	X
270.	Kuo (2010) - 16th Americas Conference on Information Systems (AMCIS)			X			X
271.	Elliot & Binney (2008) - 12th Pacific Asia Conference on Information Systems (PACIS)		X	X			X

Annexure A: Concept-Centric Literature Matrix

	Identifier		1	2	3	4	5
#	Concepts / Author/s, Year, Publication	Total per reference	Environmental Sustainability	Enabling and Transforming IS	Organisational Environmental strategy and management	Green Information Systems (IS)	Green IS and Related Frameworks
	Total per concept						
272.	Schmidt *et al.* (2010) – 16th Americas Conference on Information Systems (AMCIS)						X
273.	Molla *et al.* (2011) - Communications of the Association for Information Systems (Journal)						X
274.	Epstein & Roy (2001) - Long Range Planning (Journal)						X
275.	Ijab *et al.* (2010) - 14th Pacific Asia Conference on Information Systems (PACIS)						X
276.	Ijab & Molla (2011) - 6th Mediterranean Conference on Information Systems (MCIS)						X
277.	Hasan & Alony (2011) - 5th Israel Association for Information Systems (ILAIS) Conference						X
278.	Elliot (2009) - 22nd Bled eConference						X
279.	Watson *et al.* (2008) - Athens, GA: Global Text Project						X
280.	Watson, Williamson, Boudreau, Li, & Zeng (2011) - SIGGreen Workshop. Sprouts: Working Papers on Information Systems						X
281.	Molla & Abareshi (2011) - 15th Pacific Asia Conference on Information Systems (PACIS)						X
282.	Molla (2009b) - 20th Australasian Conference on Information Systems (ACIS)						X
283.	Molla (2009a) - 13th Pacific Asia Conference on Information Systems (PACIS)						X
284.	Molla, Cooper, & Pittayachawan (2009) - 30th International Conference on Information Systems (ICIS)						X
285.	Molla *et al.* (2008) - 19th Australasian Conference on Information Systems (ACIS)						X
286.	Butler (2011b) - 19th European Conference on Information Systems (ECIS)						X
287.	Dedrick (2010) - Communications of the Association for Information Systems (Journal)						X
288.	Jeffers (2010) - International Journal of Operations & Production Management (Journal)						X
289.	Chen, Yu, Liaw, & Huang (2010) - International Journal of Environmental Science and Technology (Journal)						X
290.	Harmon & Demirkan (2011b) - IT Professional Magazine (Journal)						X
291.	Donnellan *et al.* (2011) - IT Professional Magazine (Journal)						X
292.	Nedbal *et al.* (2011) - 17th Americas Conference on Information Systems (AMCIS)						X
293.	Erek *et al.* (2011) - 15th Pacific Asia Conference on Information Systems (PACIS) – possible duplicate of Loeser, Erek, Schmidt, Zarnekow, & Kolbe (2011) - 17th Americas Conference on Information Systems (AMCIS)						X
294.	Molla *et al.* (2010) - RMIT University. Report						X

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	Total per concept						
295.	Green Jr, Zelbst, Bhadauria, & Meacham (2012) - Industrial Management & Data Systems (Journal)						X
296.	Molla (2008) - 19th Australasian Conference on Information Systems (ACIS)						X
297.	Butler (2011a) - The Journal of Strategic Information Systems (Journal)						X
298.	Meacham *et al.* (2013) - Management Research Review (Journal)						X
299.	Gholami *et al.* (2013) - Information & Management (Journal)						X

Annexure B: Interview Guide

MAIN INTERVIEW QUESTIONS

NB: I will only ask you about things that you should feel comfortable telling me about; if you do not feel comfortable answering a question, you are welcome not to answer it.

1. How do banking organisations ensure (internally and throughout the economy) that:
   1.1. The depletion rate of non-renewable resources (e.g. fossil fuels) are within the development rate for renewable substitutes;
   1.2. The consumption rate of renewable resources (e.g. water, oxygen, wood products, food items) are within the environmental regeneration rates; and
   1.3. The waste emission rates (e.g. e-waste, emissions) are within the environmental assimilation rates?
   1.4. Are there any uncertainties, ambiguities, complexities, risks, or opportunities regarding the availability and type of information about these interactions with the environment?
2. Do/can Information Systems (IS) enable banking organisations in any way to ensure any of the items in question 1, and if so, how?
3. Do/can Information Systems (IS) transform banking organisations in any way to ensure any of the items in question 1, and if so, how?
4. How does/can environmental strategy and management affect Information Systems (IS) enabling or transforming banking organisations in this regard, if any?
5. How does/can economic value or profits and costs affect Information Systems (IS) enabling or transforming banking organisations in this regard, if any?
6. How does/can a banking organisation's own environmental sustainability affect the environmental sustainability of other external organisations and the general economy, and vice versa?

Annexure C: Focus Group Agenda

Agenda Item Description	Duration
Pre-session preparation (researcher does preparation):	
• Set out seating, name cards, water and drinking glasses, sweets and muffins, pens and notepads.	
• Setup and test recording device.	
• Hand out hard copies of framework (as already sent out on the invitations) and informed consent forms.	
1. Introduction (session begins – moderator runs introduction):	10 min.
• Greet all participants in session and thank them for participating.	
• Request cell phones to be put on silent and only urgent calls to be taken.	
• Introduce the researcher and moderator and summarise their roles.	
• Present the research goals for the session.	
• Ensure confidentiality and anonymity of the resulting data by the researcher.	
• Ask permission to audio record session for ease of analysis, instead of note taking.	
• Obtain informed consent forms.	
• Present the format of the session.	
• Present the rules of the session (one person to speak at a time due to transcribing difficulties, open session/debate, everyone's views are important, there are no right or wrong answers, please respect all comments from other participants, adhering to the time limits for each research question, and that a report of the findings will be given to each participant after analysis).	
• Allow each person to briefly introduce themselves (first name and involvement in sustainability only, to avoid any dominance by way of titles).	
2. Discussions topics (moderator runs discussions):	60 min.
• How important/not important are the concepts and interrelationships, as depicted in the framework, for organisational environmental sustainability in your industry?	30 min.
• Do you agree/disagree that Green Information Systems (IS) have the capability to enable (provide the means for) organisational environmental sustainability transformation?	15 min.
• Do you agree/disagree that Green Information Systems (IS) have the capability to transform (be the cause or driver of) organisations for environmental sustainability?	15 min.
3. Ending the session (session ends – moderator runs ending session):	5 min.
• Thank the participants for participating.	
• Reiterate that a report of the findings will be given to each participant after analysis.	