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TOWARDS A MUTUALLY SUSTAINABLE ENVIRONMENTALLY FRIENDLY INFORMATION TECHNOLOGY POLICY FRAMEWORK FOR SOUTH AFRICAN SMALL, MEDIUM AND MICRO ENTERPRISES

Mini-dissertation by

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ABSTRACT

Title: Towards a mutually sustainable environmentally friendly information technology policy framework for South African small, medium and micro enterprises.

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A number of problems have served as motivators for this study: Environmental deterioration as a risk to economic facilitation; missed organisational green competitive opportunities; South Africa's need as a developing country for the growth of small, medium and micro-enterprises (SMMEs); and information technologies as an aid for ecological and economical problems. Accordingly, this research has aimed to suggest environment-friendly information technology policies that can be implemented in South African SMMEs, engendering mutually beneficial sustainability for the three domains (or contextual study elements) 'Environment', 'Organisation' and 'Information Technology'.

The methodology used involves an interpretive research approach, a literature survey based on document analyses, and an empirical study based on green information technology expert interviews. In collecting the data, the theory of three of the five Multiple Perspectives Approach perspective types was applied; for the data analysis, the Hierarchical and Signed components constituting the Directed Graphing Method where applied.

The output of this study includes an explanation of the relationships that exist between the study elements and that lead to mutually beneficial sustainability. It also includes the identification of Key Sustainability Factors for each of the research elements, as high level critical goals to be achieved by green information technology policy developers in pursuing mutually beneficial sustainability. Furthermore, the output contains contextually consolidated Key Sustainability Factor Enablers, to serve as policy recommendations for implementation by green information technology practitioners toward ensuring mutually beneficial sustainability; and, finally, a sample integration of these Key Sustainability Factor Enablers, now referred to as Conceptual Policy Views, such as may have been produced by typical green information technology policy developers in selecting and prioritising views for organisational utilisations.

In answering the main research question of this study, as well as providing its key outcome, a conceptual framework has been produced which comprises information technology policies that are supported to be feasible for implementation as well as of mutual benefit in terms of sustainability for the ‘Environment’, South African SMME ‘Organisations’ and ‘Information Technology’ itself. This provides an ordered and related means of implementing information technology policies, while also relating these policies to their respective mutually beneficial Key Sustainability Factors. Strategic planning, toward incorporating the conceptual framework into organisational policy, is thus enabled. This study concludes with an evaluation of its findings and execution, together with future research recommendations.

Keywords: sustainability, green IT, environment-friendly, eco-friendly, conceptual framework, South Africa, SMME.

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CHAPTER 1

INTRODUCTION AND RESEARCH RATIONALE: TOWARD MUTUALLY BENEFICAL SUSTAINABILITY

1. Introduction

At the Telecom 95 conference, Nelson Mandela expressed the wish that the information revolution should be applied toward global economic prosperity (Davison *et al.*, 2000: 6) by using information technology to accelerate development and economic growth (Davison *et al.*, 2000: 2). This study sets out to contribute to the body of knowledge regarding this cause, in that it seeks to suggest means of applying information technologies toward creating such desirable economic results. In doing so, this research focuses on the concept of sustainability; as being accomplishable via information technology, and as being beneficial not only for the economy, but also for the environment. Concerning Mr Mandela's call for the application of information technology to economic development, the present research topic aims specifically at application within the South African SMMEs market, a context in which vast development opportunities exist. From the beginning, this research study was intended to provide a conceptual working framework of information technology policies, to be analysed for their feasibility as well as for being of mutual benefit in terms of sustainability of the 'Environment', South African SMME 'Organisations' and 'Information Technology'.

The purpose of this chapter is to introduce the research assignment, to set out its basic scope and to describe the resulting activities. This is done by introducing the research topic, describing the problem statement, establishing the research context and research objectives, formulating research questions, indicating key study concepts, anticipating expected research results, setting research limitations,

projecting possible contributions to the field of information systems and providing a brief précis on the content to be expected within each chapter of this research document.

2. Research topic

For this study in the field of information systems, the chosen research topic was *"Towards a mutually sustainable environmentally friendly information technology policy framework for South African small, medium and micro enterprises".*

This topic suggests an attempt to produce a framework of information technology policies, as well as the creation and/or maintenance of resultant mutually enabling sustainability levels – for information technology by itself, for the environment and for South African small, medium and micro enterprises – via interrelationships existing among these three entities.

High-level motivators for addressing this subject include pressing circumstances surrounding the elements outlined in the topic, and a lack of local attention regarding the subject. A detailed problem statement provides further specificity regarding the drive for this research.

3. Problem statement

The problem encompassed by the title to this thesis exists in both theory and practice, and proposals for a solution need to be developed. The first task will be to outline the three elements - environment, organisation, and information technology - to be drawn together in the context of the South African SMME; the second, to show up their interrelationship; the third, to establish their mutual sustainability.

3.1 The environmental element

Ecological deterioration has led to a world-wide state of crisis. Examples include biodiversity loss, atmospheric pollution and greenhouse emissions. Continued exploitation of nature will destroy the natural environment irrecoverably and leave future generations powerless (Chen *et al*., 2008: 188-194). It is said that ecosystems support economies, and not the other way round (Jennings & Zandbergen, 1995: 1015). Sustainability of the environment is thus a pressing and present concern.

3.2 The organisational element

Organisations relate to the environment in that ecological and organisational sustainability have both become necessary. The welfare of an environment concerns all organisations as entities residing within it (Chen *et al*., 2008: 193). Organisations need to organise and adjust their behaviour towards the effect of environmental deterioration on their industries, in their pursuit of remaining competitive (Chen *et al*., 2008: 194). Pollack (2008) claims that the conversion of environmental issues into sustainable business practices can considerably improve organisational performance levels. Chen *et al*. (2008: 188) accordingly propose a change in organisational business models towards sustainability, by incorporating ecological solutions.

3.2.1 The South African SMME context

Globally, SMMEs constitute more than 90 % of all businesses (International Organisation for Standardisation, 2009a). South Africa is known as a third-world, but developing, country; and consequently entrepreneurship and the corresponding emergence and sustainability of SMMEs are vital for country-wide

growth. Long-term economic sustainability is in turn dependent on environmental assets, as the existence of biological and organisational entities relies on ecosystems (Chen *et al*., 2008: 187). SMMEs are claimed to be the most promising section of South Africa's economy, especially in terms of income distribution and productivity, as they are said to have the best potential to create employment opportunities (Berry *et al*., 2002: 4-11). The South African context, with specific focus on SMME organisations as means toward development, thus offers an opportunity for contributing to the domain. Information technologies, implemented toward mutual sustainability benefits for such SMMEs, for the environment and for the information technologies themselves, thus offer prospects of enabling such advancement of SMMEs.

3.3 The information technology element

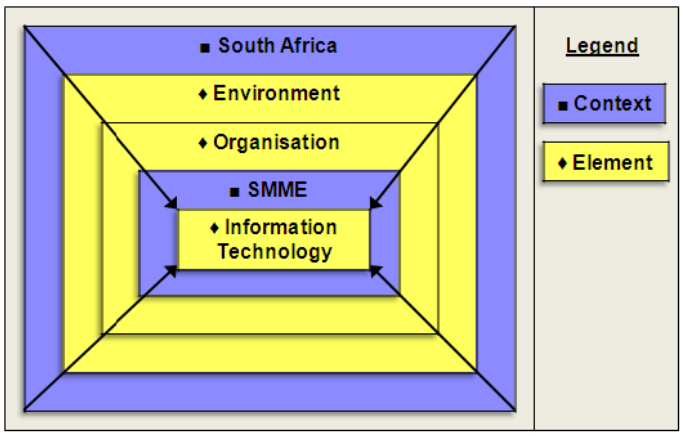
In response to the stated concerns, the literature advocates information and communication technologies as having a key role to play in addressing various social, ecological and economical problems; even though it is not always known how (Mulvihill & Milan, 2007: 661). Researchers are in agreement with regard to the influence of information systems on institutional properties which stimulate eco-friendly behaviour (Chen *et al*., 2008: 188). Information systems are being announced as essential in pursuing ecological sustainability (Chen *et al*., 2008: 187), while the notion of green and sustainable information technologies as an aid is consequently widely promoted (Pollack, 2008).

4. Research scenario

Within the scenario of the stated research problem, South Africa, its 'Environment', its SMME 'Organisations', 'Information Technology' and the concept of sustainability are evidently key study domains.

In the literature, patterns were identified that indicate distinct categories of discussion of the topics of sustainability regarding the environment and organisations, and of the role information technology could play in this context, but not of these study elements taken together, from an integrated point of view. There exists a need for a combined perspective on information technologies, the environment and organisations as mutually beneficial partners toward three-way sustainability levels; clarification of this perspective is the solution to the stated research problem. An exciting opportunity thus presents itself, regarding the benefits possible in applying information technology as part of a business operation toward improving organisational outcomes. It furthermore motivates and supports the research topic's application to the developing South African SMME context, to an even greater extent. Figure 1.1 provides a graphical representation of the envisaged research context.

Figure 1.1: Research context



4.1 Element interrelations toward sustainability

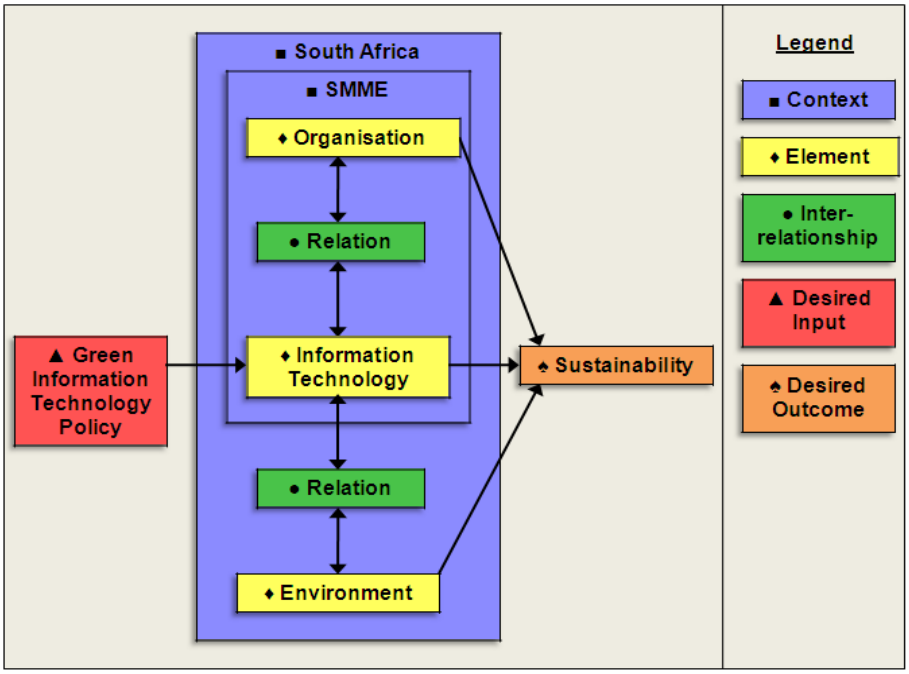
Key to this research project is the literature that supports that a complex, but vital, relationship exists between information and sustainability (Mulvihill & Milan, 2007: 657), and that information systems are of the essence in pursuing ecological

sustainability (Chen *et al*., 2008: 187). In addition, it is advocated that what is good for the environment is also good for business (Pollack, 2008) and that businesses increasingly miss out on great benefits while not considering green opportunities (Olson, 2008: 28). Jennings & Zandbergen (1995: 1015) also state that it is ecosystems that support economies, not the other way round. Finally, Chen *et al*. (2008: 188) propose that an ecological solution will require a change in organisational business models, by incorporating ecological solutions toward sustainability. Consequently, organisations can reduce their harmful impacts on the environment, while bettering their efficiencies and reducing their costs, by using the opportunities offered by the implementation of green information technology standards (Olson, 2008: 27). This fully motivates and supports the application of the proposed research topic to the developing South African SMME context.

From this, one recognises the existence of underlying relationships between the 'Environment', 'Organisation', information supported by 'Information Technology', and sustainability levels. Information technologies appear to be at the core of this union. An opportunity, based on these interrelationships, exists for information technology to sustain itself; not only within organisations utilising information technology, but also within information technology as an industry. In this way, organisations can promote their own degrees of sustainability, via information technology strategically applied within the environment; while in turn increasing the sustainability levels of the environment. An example of such environmental upliftment may be that of job creation via the facilitation of newly implemented green information technology practices. Similarly, 'Information Technology' should not be perceived as sustaining itself on its own, but rather the opportunity for information technologies to sustain itself within the context of South African SMMEs should be regarded, for the purposes of this present study. A further relationship, namely that between the 'Organisation' and 'Environment', should be

acknowledged, as facilitating relationship and existing between that of SMMEs and the environment; with the 'Organisation' and 'Information Technology' being embedded within the SMMEs context. The achievement of mutual sustainability levels among the entities serving as research topic elements may thus contribute to the sustainability of these systemic elements as a whole. Figure 1.2 provides a graphical representation of the interrelationships existing between the research elements.

Figure 1.2: Element interrelationships



5. Research objectives

The objective set for this research was to arrive at a conceptual framework, comprising recommended information technology factors, to be considered as a whole by organisations in establishing environment-friendly practices for the mutual benefit of the entities 'Organisations', 'Environment' and 'Information Technology', to be measured in terms of increasing sustainability levels. This output has been

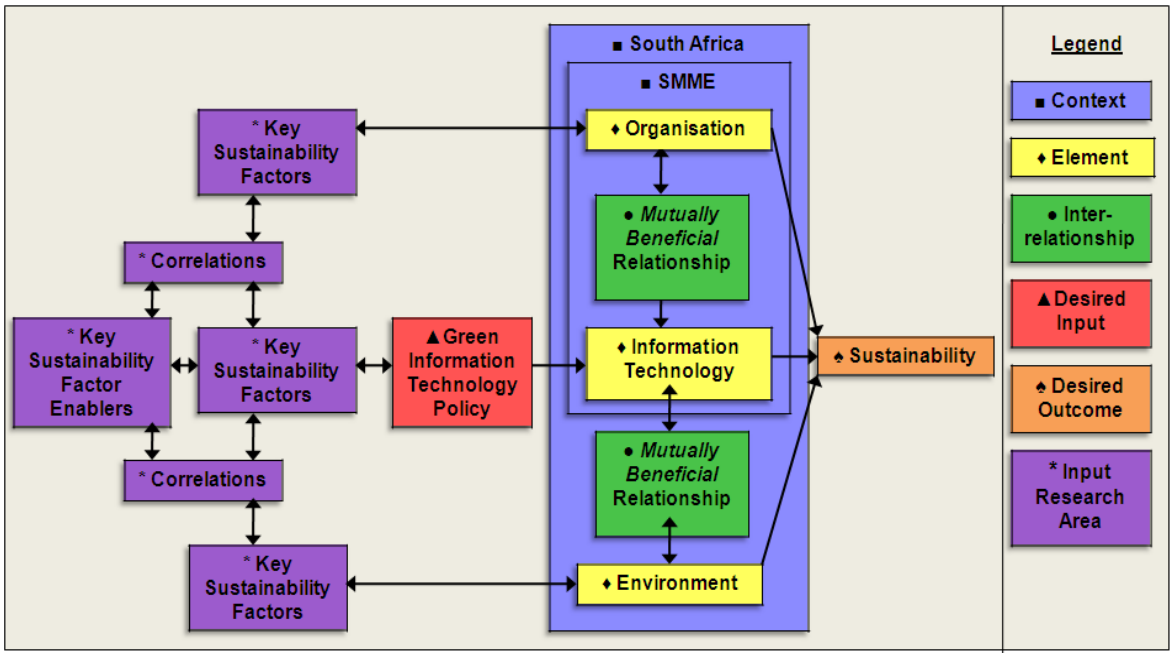
developed so that it can aid in countering environmental deterioration and its effects on organisations. The conceptual framework has been set up for reference within the context of South African SMMEs, and may accordingly prove valuable in guiding decision-makers in developing mutually sustainable and environment-friendly information technology policies. A consideration that was included was that the SMMEs might not be formal in their approaches regarding policy implementation, and that government dictation on such matters might seem necessary in guiding implementation aspects.

5.1 Research focus

After developing a conceptual framework that will enable the generation of mutually beneficial sustainability levels for South African SMME 'Organisations', the 'Environment', and 'Information Technologies', it was necessary to identify how the existing relations between the stated elements may be applied to establish mutually beneficial relationships.

A research focus was derived in a logical process, as follows: It comprises firstly the identification of Key Sustainability Factors per element; secondly, the acquisition of a Key Sustainability Factor Enablers list for the elements combined; and thirdly, the recommendation of subsequent correlations among the research element enablers, in order to produce element relationships of mutual benefit. The resulting product is this conceptual framework containing guiding factors, which it is suggested should be used in developing environment-friendly organisational IT policies, toward creating increased sustainability levels for all elements. Figure 1.3 provides a graphical representation of the research focus, including context and intended research areas, aimed at producing the solution to the given research problem in the form of a framework of mutual sustainability benefits.

Figure 1.3: Research focus areas



5.2 Research questions

In accordance with the research topic, research objective and -focus areas, the following is the natural main research question to be pursued in developing the proposed conceptual framework:

> *"What set of factors should South African SMME organisations seek to implement when instituting an environment-friendly information technology policy that consists of mutually beneficial sustainability relations between the organisation, the environment and information technology?"*

The answer to this main research question will be sought by answering the following secondary research questions:

In chapter 3:

> *“What key sustainability factors are respectively required in South Africa for a typical SMME organisation, the environment, and information technology?”*

In chapter 4, based on the findings of chapter 3:

> *"How can the respective key sustainability factors of a typical SMME organisation and the environment be realised, in terms of information technology approaches that also adhere to the key sustainability factors of information technology, in South Africa?”*

In chapter 5, based on the findings of chapters 3 and 4:

> *“How do the mutually beneficial key sustainability factor enablers, required in South Africa to respectively sustain a typical SMME organisation, the environment and information technology, correlate with each other?”*

Finally, for the listed research questions, the status variables which may be taken into consideration when arriving at various research outcomes, are those of the Key Sustainability Factors which relate to the entities 'South African SMME Organisation’, ‘Environment’, and ‘Information Technology’. The resulting dependent variables, being various outcomes based on the status variables, may consequently occur in the form of identifiable Key Sustainability Factor Enablers. Independent variables will in turn be present since researcher control or manipulation is possible during the generation of correlations between the applicable study elements, based on the two variable type results just mentioned (Hill, 1980: 16).

6. Literature review

An initial qualitative literature search was carried out for sources relevant to the focus of this research study. It was found that limited sources exist regarding the specific topic chosen. The only relation existing between the focus of this study and previous studies is a similarity in terms of the study of relationships between individual elements of this study's elements, and sustainability. Extensive use was made of recent scholarship in conducting the literature review, the goals of this study being current and modern in notion. The most valuable contributions came from Chen *et al*. (2008), Olson (2008) and Mulvihill & Milan (2007). It appears that the results of the studies conducted by Chen *et al*. (2008) are closest in relation to the purpose of this research study.

Doing this literature review led to the identification of the following themes, both in theory and practice, which were used as guide in the present work:

- Methodologies**:** A wide variety of methodologies are used in studies belonging to fields close to that of the present research. Document surveys, experiments and interviews show slightly more frequent use but do not indicate any definite methodological preference. Methodologies are extensively combined. This has guided the present research in making use of methods advocated to be most suitable, such as interviewing; and also in applying various methodologies in order to achieve the study outcomes, namely the Multiple Perspectives Approach and the Directed Graphing method.
- Units of analysis***:*** For the key research concepts identified, the most popular units of analysis are in terms of organisation regarding sustainability; of group regarding the environment and organisations; and of both organisation and group levels regarding information technologies. Individual units of analysis are rarely used. Accordingly, the current research on the pertinent subject areas is mostly focused on organisational units of analysis. Throughout this study, an

organisational unit of analysis was followed which relates to the study context, having the origin of information technology applications toward mutual sustainability within them.

- Domain exclusion*:* Within the limits of the literature review conducted, sources could persistently be divided into distinct groups which each addressed a single specific angle of the research topic, but never more than one. These groups include that of addressing the South African context in terms of various key concepts, that of promoting information technology as a means to sustain the environment, that of advocating the environment as a way of sustaining information technology, those addressing only environmental issues, and that discussing the relationship between information technology and the environment. This finding highlighted the need for a combined perspective on information technology and the environment as mutually beneficial partners toward sustainability for South African SMME organisations.
- Domain significance*:* Authors incessantly stress the detrimental influence of environmental degradation on organisations, and the accompanying thought that the status of the environment should be considered important in evaluating the sustainability levels of organisations, in order improve this situation. Examples of this would include the statements that the need for large-scale transformation is clear but wrongly being ignored at strategic levels in businesses (Olson, 2008: 22); that the exploitation of nature will leave the natural environment deteriorating irrecoverably and leave future generations powerless; that long-term economic sustainability is dependent on environmental capital; that the existence of biological and organisational entities rely on ecosystems (Chen *et al*., 2008: 187); and that environmental issues converted into sustainable business practices can significantly enhance organisational performance levels (Pollack, 2008).

Specifically the last-mentioned statement points to the possibilities of applying information technology, as a part of any business operation of the time, in order to improve business bottom-lines; and motivates and supports the application of the proposed research topic to the developing South African SMMEs market context even more.

6.1 Key concepts

The researcher has identified the key concepts namely ‘Organisation’, ’Information Technology’, ‘Environment’ and sustainability for the purposes of this study; based on the research topic and elements, for use as set literature investigation parameters. In however reviewing literature relating to these parameters, the researcher had to draw on a number of academic areas; including information technology, business and economics, natural sciences as well as governing laws and standards specific to the research context. Throughout this process the researcher has thus identified a number of variances in terminologies, which may refer to subjects similar to that of the key concepts. These have been grouped within table 1.1 below for perusal.

Table 1.1: Research concepts analysis

Concept Root	Variances in Terminology							
	Concept	Review Occurrences	Concept	Review Occurrences	Concept	Review Occurrences	Concept	Review Occurrences
Organisation-root	Organisation	5	Business	3	Corporate	1		
	Corporate image	1						
Information Technology-root	Information Technology	4	Information Systems	1				
Green-root	Green IT	1						
	Green data centre	1						
	Internal greening	1						
	Green	4						
	Green certification	1						
Corporate-root	Corporate greening	2						
	Corporate environmental management	1						
Strategy-root	Enterprise-level green strategy	1						
	Strategy	3						
Economic-root	Economic	2						
	Information economy	1						
Social-root	Institutional theory	2						
	Information society	1						
Systems-root	Environmental management system	1						
Development-root	Leapfrog	1	Growth	1	Performance	1		
Sustainability-root	Sustainable	3	Sustain-ability	2	Sustain	1	Maintain	1
	Information sustainability	1						
Internal-root	Information waste	1						
	Internal objective	1	External objective	1				
	Institutional legitimacy	1						
Envirnoment-root	Environment	8	Ecology	4	Natural ecology	1	Natural environment	1
	Information ecology	1						
Eco-root	Eco-effectiveness	1						
	Eco-equity	1						
	Eco-efficiency	1						
Pressures-root	Institutional pressure	1						
	Challenges	1						
Motivators-root	Benefits	1	Oppor-tunities	1	Motivate	1		
	Configurational determinants	1	Charac-teristics	1				
Systemic-root	System	1						
	Level	1						
	Relationship	1						
Contextual-root	Framework	1						
	Paradigm	1						

The purpose of this exercise was to indicate the respective assemblies in terms of their variances in terminology, their related concepts and their importance according to number of occurrences; thus indicating, and increasing understanding of, the key concepts themselves, their relations to one another in terms of roots and their descriptive definitions. It has been derived that the

concept roots of size, constructs, frequency, date, organisation, information technology, green, corporate, strategy, economic, social, sustainability, internal, environment, eco, pressure, motivator, systemic, contextual and terms, apply to the research context. This analysis accordingly provided classifications of concepts, as well as confirmations of the importance of the identified key concepts; based on their high number of review occurrences as well as high number of alternative concepts in use. The key concepts, together with their alternative terminologies, were thus collectively applied within various data collection activities, when conducting the relevant information searches.

Descriptive definitions of the key concepts are next provided, with fundamental meanings, inclusions and exclusions, the research scenario focus, and pertinent data collection domains, as understood from a global view:

- An *organisation* is described as an organized body of people with a particular purpose, such as a business; formed to achieve a particular aim (Oxford University, 2005: 1030).
- *Information technology* is in turn defined as the study or use of systems such as computers and telecommunications for storing, retrieving, and sending information (Oxford University, 2005: 765).
- The concept *environment* is next explained as the surroundings or conditions in which a person, animal, or plant lives or operates, as well as the natural world, especially as affected by human activity; and in relation to computers, as the overall structure within which a user, computer, or program operates (Oxford University, 2005: 490).
- Finally, *sustainability* is delineated as the ability to be sustained or the avoidance of depletion of natural resources within an industry, development, or agriculture by the Oxford Advanced Learner's Dictionary (Oxford University, 2005: 1492); thus bearing relevance to an organisational perspective of sustainability, as in profit-generating economies. Chen *et al*. (2008: 187) in turn

describe sustainability as “development that meets the needs of the present world, without compromising the ability of future generations to meet their needs”; in referring to an environmental and developmental context of it. Sustainability as concept can be applied toward having varied implications for different scenarios. Organisations should meet the sustainability needs of economic, social and environmental concerns concurrently, toward achieving long-term success and maintenance (Chen *et al*., 2008:187). Chen *et al.* furthermore describe sustainability of the ecological type as “ the ability of one or more entities, either individually or collectively, to exist and thrive, either in unchanged or in evolved forms, for lengthy timeframes; in such a manner that the existence and flourishing of other collectivities of entities is permitted at related levels and in related systems”. For the present purpose, sustainability is considered as a concept from a green IT perspective; implicating ongoing and maintained existence of each of the study elements, as focus.

These key concepts, together with their alternative terminologies, are applied and interpreted according to these definitions throughout this work, with the goal of maximising literature survey outputs, reaching the most suitable interview candidates and executing interviews using terminology that corresponds with such interview candidates’ reference systems, thus collecting and analysing data in an appropriate manner.

7. Expected research results

The results of this research project were expected to be of a normative nature, providing knowledge on intervention factors that may be implemented toward achieving desired outcomes (Robinson, 2001: 58); in terms of a conceptual environment-friendly practice framework of sustainability for the mutual benefit of South African SMME ‘Organisations’, the ‘Environment’ and consequently

'Information Technology' in itself. They were proactively directed at achieving a conceptual framework that is compatible, generalisable, reproducible and contextual (Esteves *et al*., 2002: 130).

More specifically, it was anticipated that mostly strategic-, technical- and procedural principles would be generated for inclusion within the intended conceptual framework output; thus providing for a high-level solution to the main research question formulated in section 5.2. While the conceptual framework principles emerging from this research study were expected to mainly concern recent trends and solutions as perceived by knowledgeable industry representatives, the intended and thus expected focal result of this research was the generation of new knowledge about the relationships among these principles and their corresponding elements.

8. Research limitations

In delineating the limitations of this research study, it is important to recognise its scope. The scope (Webster & Watson, 2002: xv) of this research project falls within the contextual limitation (Webster & Watson, 2002: xv) of South Africa as geographic region. Organisations falling into the size category of small-to-medium-and-micro enterprises were studied, while the policies framework produced was meant to apply to all types of organisations, whether these be hosting, selling, producing or utilising information technology products. All organisational industry types were thus included in this research. In turn, information technology was addressed on a conceptual level, while consideration was also given to the anticipated influences of the researcher's own cognitive structures of meaning. For the unit of analysis, an organisational level was chosen; while, overall, the analysis (Webster & Watson, 2002: xv) was confined to a single level, with information technology at the core of the complete study.

As a result, this research project, its processes and outcomes will specifically exclude the following: consideration of governing bodies or methods that are able to enforce the proposed concept; the issue of organisations deviating from the suggested environment-friendly information technology practices; and remedies already taken up within the South African law system. The time period referred to during the proposed analysis covers the current South African situation, i.e. from November 2010 to end January 2011; while literature from any timeframe will be considered regarding the environment.

With regard to temporal limitations (Webster & Watson, 2002: xv) experienced during this study, the only instance is that of the limited sources of information available in the given context. As yet, it was impossible to locate any reliable sources of discussion on the mutually beneficial role that may be created between the environment, organisations and their information technology practices.

9. Contribution to the field of information systems

This research study attempts to extend the existing body of knowledge in the subject area, especially with regard to its theoretical significance. A number of improvements or changes, of relevance to both researchers and practitioners, were aimed for. These include:

- Innovations in the form of new terminology regarding information and sustainability (Mulvihill & Milan, 2007: 667), as a result of theoretical treatment.
- The development of a progressively inclusive conceptual framework for the domain of study, as well as increased academic understanding of the relationship between information technology and ecological sustainability (Chen *et al*., 2008: 193).
- Practical relevance was aimed for within the information technology industry. This may lead to opportunities for increased value of products and services

entering new viable markets, due to ecological product enhancements. A new way of thought regarding the problem scenario may also be prompted within the industry, leading to revised practices (Jennings & Zandbergen, 1995: 1038).

- The manner in which people conduct their professions may be modified, if information technology supplier and consumer organisations adapt their practices toward achieving green information technology certification as a status symbol. Benefits such as reduction in information technology waste; its control, distribution costs, energy savings; and decreased consumption (International Organisation for Standardisation, 2009b) may also result.
- Possible changes to decision-making criteria regarding the application of information systems, making green information technologies a strategic organisational option (Olson, 2008: 22).Creating awareness of environmental thinking, and instilling and spreading appropriate practices (Jennings & Zandbergen, 1995: 1038) in the South African context.

When evaluating the contribution made by this research project, one should consider that it is specifically focused on the South African and SMMEs situation; this has so far received little research attention in the domain. Further value may lie in the fact that this research aims to combine seemingly disparate lines of environmental, organisational, information technological and sociological knowledge bases, primarily for use by the information technology industry.

10. Research structure

The following is a condensed preview of this thesis

Chapter 2, Research approach: Toward multiple interpretive policies:
This chapter considers the introduction, motivation, theoretical basis and intended application of the selected research paradigm, methodology and methods,

namely: Interpretivism, a literature survey, and an empirical study. In preparation for their execution in consequent chapters, these are discussed in terms of the Multiple Perspectives Approach (Courtney, 2001: 29-31), for the relevant perspectives of 'Technical', 'Organisational', and 'Personal' (Bennets *et al*., 1999: 198), and with high-level role for the 'Ethical' perspective (Courtney, 2001: 29); which was included in the 'Technical', 'Organisational' and 'Personal' perspectives as an influencing consideration.

Chapter 3, Literature Survey: Toward Key Sustainability Factors:
This chapter formulates and answers the secondary research question, *"What key sustainability factors are respectively required in South Africa for a typical SMME organisation, the environment, and information technology?"* (see section 5.2), by qualitatively reviewing the literature found and discussing these findings. As output, three contextually consolidated lists are generated which contain qualitatively interpreted sustainability considerations for each of the research elements: 'Environment', 'Organisation' and 'Information Technology'.

Chapter 4, Empirical Study: Toward Key Sustainability Factor Enablers:
This chapter deals with a deepened investigation into specific recommendations, namely, Key Sustainability Factor Enablers, which should be followed for the respective Key Sustainability Factors to be achieved, in answering the secondary research question, *"How can the respective key sustainability factors of a typical SMME organisation and the environment be realised, in terms of information technology approaches that also adhere to the key sustainability factors of information technology, in South Africa?"* (see section 5.2). This is achieved by consulting suitably selected and profiled green information technology industry experts, via semi-structured interviews which were executed according to the Multiple Perspectives Approach and an interviewing strategy including the Five W's method. As output, this chapter provides information on the procedure followed;

data collected in the form of an interviewing record; and a consolidated list of the recommended mutually beneficial Key Sustainability Factor Enablers within the study context and status.

Chapter 5, Synthesis and Interpretation: Toward Integrated Conceptual Policy Views:

This chapter assumes an answer to the secondary research question *"How do the mutually beneficial key sustainability factor enablers, required in South Africa to respectively sustain a typical SMME organisation, the environment and information technology, correlate with each other?"* (see section 5.2), by identifying and examining hierarchical levels and resulting relationships among Conceptual Policy Views (previously referred to as mutually beneficial Key Sustainability Factor Enablers). The data synthesis and interpretation exercise is achieved by applying Directed Graphing theory, as pertaining to the Multiple Perspectives Approach, via the production of a Hierarchical Reachability Matrix and Iteration Matrices, as well as of a Signed Block Partitioned Reachability Matrix, Directed Graph and Hierarchical Polarisation. As output, an overall systemic analysis of the Conceptual Policy Views set is generated, based on the stability and suitability levels found for it, in order to ascertain its feasibility as suggested prototype conceptual framework for implementation by South African SMMEs, when they set out on their mutually beneficial and environment-friendly information technology practice.

Chapter 6, Conclusion and Research Review: Toward Conceptual Framework Implementation:

This chapter answers the main research question, *"What set of factors should South African SMME organisations seek to implement when instituting an environment-friendly information technology policy that consists of mutually beneficial sustainability relations between the organisation, the environment and information technology?" (*see section 5.2), by introducing a prototype conceptual

framework as overall research output, based on the findings of all the preceding chapters. This conceptual framework provides an ordered and related means of implementing the information technology policies while relating these policies to their respective mutually beneficial sustainability effects per element, thus enabling appropriate strategic planning by the green information technology user or decision-maker. In concluding the research project, complementary conclusions are given in the form of recommendations for conceptual framework implementation, anticipated implications, knowledge contributions and knowledge gaps, and future research.

11. Conclusion

The purpose of this first chapter was to establish the foundation of this study, mainly in terms of its scope and the activities to be carried out in consequent chapters. This has primarily been achieved by introducing the research topic; describing its problem statement in terms of a sustainability opportunity being overlooked; setting out its research context with South African SMMEs and any pertaining information technology domain; delineating one main and three secondary research questions; indicating its four key study concepts; anticipating that the research results would form a conceptual framework; outlining its research limitations; projecting possible contributions to the field of information systems; and outlining the content of each subsequent chapter of this research document.

Within chapter 2 to follow, this study progresses from chapter 1's research introduction and grounds setting toward the carrying out of the research endeavour, by means of next establishing and motivating a research approach; in terms of paradigm and methodology, as well as its intended application and execution.

CHAPTER 2

RESEARCH APPROACH:
TOWARD MULTIPLE INTERPRETIVE POLICIES

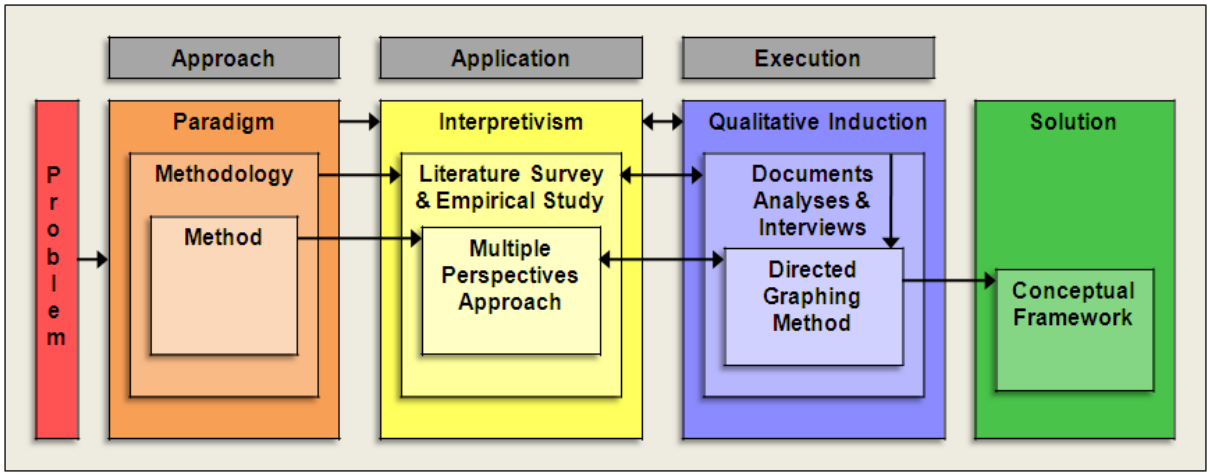
1. Introduction

The purpose of this chapter is to establish and motivate the selected research approach, starting from the foundations in chapter 1. This is achieved by introducing, motivating and discussing the theory of the selected paradigm and methodologies; with focus on a literature survey and an empirical study as data collection method. The application and the execution of the described methods are also set out. Similarly, the chosen data analysis method is mentioned but specifics regarding its suitability and execution are deferred to a later chapter. This chapter concludes with a brief discussion of the intended research standards.

2. Research approach

The main approach selected for this research project was Interpretivism, with a qualitative focus, as paradigm; a literature survey combined with an empirical study, comprising document analyses and interviews, as methodology; and the Multiple Perspectives Approach, based on unbounded systems thinking, as method. Detailed discussions of these approach components, their appropriateness to the study and intended application methods follow. Figure 2.1 provides a graphical representation the research approach.

Figure 2.1: Research approach selection



2.1 Paradigm

The research paradigm chosen to represent the epistemological and ontological foundations of the proposed research study is that of Interpretivism; specifically in the form of internal realism, which may be described as the consideration of reality as an inter-subjective construct that is shared among individuals (Nandhakumar & Matthews, 1997: 110). In the field of information systems, Interpretivism is described as concerning the understanding of the social context of information systems, in terms of the social processes by which they are construed via people, and through which such pertaining people influence and are influenced by their social setting. This paradigm may contain multiple subjective realities, have dynamic meaning and produce multiple interpretations (Oates, 2007: 292), thus suitably relating to the research topic and goals. Correspondingly, qualitative research, the main type of data utilised by interpretive researchers, is chosen for the further approach. Examples of such qualitative data anticipated to be drawn on via the proposed research study include data, words and sounds; collected via interview tapes,

researcher's field notes, company documents and subject literature (Oates, 2007: 266).

Authors who have originated the interpretive research paradigm within the social sciences include Cicourel (1964) and Garfinkel (1967), both within RWJ Foundation (2008). Gadamer *et al.* (2004: 194) advocated understanding being influenced by context and biases or values on the part of the researcher; while stating the effects of history on human consciousness. Chen & Hirschheim (2004: 199) claims that Interpretivism was gaining increased academic importance. Interpretivism is applicable to the information systems field of study, as it facilitates the creation of rich understandings of research contexts (Nandhakumar & Matthews, 1997: 111). According to Burrell & Morgan (1979: 260) the social world is subjectively constructed by humans who create shared meanings; existing in their minds through common language and interactions. Considering information systems for real-world social- and organizational contexts (Oates 2007: 1-2), for complex and hidden social structures (Fitzgerald & Howcroft, 1998: 163) and for uncontrollable environmental variables (Goede & De Villiers, 2003: 209) thus corresponds with the goals and Interpretivism beliefs of the present study.

Interpretivism is further suited to the present research topic as it corresponds with the aim of developing a conceptual framework, and because the assumptions on which the interpretivist paradigm is based lend themselves to theory development while doing social sciences research in the information technology field. These assumptions are:

- Ontologically, physical and social realities are social products that cannot be understood independent of the social actors involved within them (Orlikowski & Baroudi, 1991: 13).

- Epistemologically, scientific knowledge is understood from the perspectives of individuals' subjective meanings and practices; which evolve from social interaction (Orlikowski & Baroudi, 1991: 14).
- Methodologically, the relationship between theory and practice is viewed as researchers always being implicated by the phenomena being studied; thus facilitating the production of differentiated perspectives per researcher interpretation (Orlikowski & Baroudi, 1991: 15).

The intended conceptual framework was produced by induction; which for the present purpose is described as the observation of categories in data during an open-minded investigation, when groupings occur to the researcher naturally (Oates, 2007: 269). The use of induction also correlates with the proposed research approach, as elaborated on in the following section.

2.2 Methodology

As stated above, a qualitative approach was followed throughout this research project. The chosen methodology consisted of a literature survey, in order to identify Key Sustainability Factors, as well as an empirical study to obtain data on Key Sustainability Factor Enablers, thus collecting high value data in accordance with the research focus: developing a conceptual solution framework. These two areas were investigated using logical reasoning and past and empirical research, thus justifying the research in itself for academia and practice (Webster & Watson, 2002: xv). The following research techniques have been applied methodologically toward answering each of the progressive research questions.

2.2.1 Literature survey

As first step during the data collection phase of this research study, a document analysis was carried out, to compile a Key Sustainability Factors list per research focus element, as follows:

- Literature: A selection of academically credible literature sources was investigated. They were of technical and non-technical nature. Only literature in support of and relating to the research context was drawn on. Sources investigated include academic publications and books.
- Documents found**:** Official publications of market leading corporate research representatives, university syllabuses as well as governing South African laws and standards, were investigated, as relevant to the research focus. An example of a research article output conglomerate is that of CIO magazine.

The above-mentioned sources were drawn from disparate industry domains, as pertinent to the specific research context, viz. from the fields of sociology, psychology, organisations, business, strategy, management, economics, ecology, environmentalism, natural sciences, information systems, information technology, politics and developing countries, for combination of their knowledge bases to obtain Key Sustainability Factors for each identified research element (Webster & Watson, 2002: xv).

In conducting this literature survey, the guidelines for doing so as set out by Webster & Watson (2002) were adhered to. The specific academic literature and document sources studied are further described in section 3.3 of chapter 3; together with the evaluation process and resultant findings of such data collection exercise.

2.2.2 Empirical study

As second step during the data collection phase of this work, the practical scenario was discussed with knowledgeable individuals from the information technology industry, to be able to construct lists of Key Sustainability Factor Enablers for each perspective by carrying out the Multiple Perspectives Approach, as follows:

- Detail interviews**:** Interviews of the semi-structured type were held with representatives of the green information technology industry, but from different domains of specialisation. By doing so the researcher was able to attain and compare views from different role players within a single industry, but from various viewpoints as pertaining to the respective interviewee domains, according to the selected Multiple Perspective types. In turn, the choice of semi-structured interviews would promote relatively detailed dialogues on issues according to a list of themes; this was in line with the Multiple Perspectives Approach; while still providing the option to ask questions additional to those of the prepared themes (Oates, 2007: 188). Interviewing the different types of representatives was aimed at contesting bias while still achieving multiple views on the subject area, in order to create a rich picture of the research problem and the anticipated resultant solution. The researcher prepared to record interview materials via audio tape and detailed field notes.
- Field notes: Detailed field notes were written throughout the interviews. Any information which the researcher felt may have been relevant was recorded as such to include in the data analysis. Examples of notes pertaining to this research study include notes on atmosphere, events, responses, comments, personal thoughts and reflections (Oates, 2007: 176).

2.3 Method

The research method selected was that of the Multiple Perspectives Approach, to be utilised during the empirical study of this research project, for reasons that will next be described with regard to the suitability of the method to the research scenario.

The Multiple Perspectives Approach follows an unbounded systems thinking approach. Unbounded systems thinking is a problem-solving knowledge system (Mitroff & Linstone, 1993: 14) which theorises that everything interacts with everything, that all branches of enquiry depend fundamentally on one another, and that the widest array of disciplines, professions and knowledge branches should all be considered fundamental and equally important for inclusion in the study (Mitroff & Linstone, 1993: 91). The Multiple Perspectives Approach is thus a general systems analysis framework, utilised for addressing messy social systems in developing contexts, by generating and classifying multiple perspectives on a given problem situation. The method was also included in order to form the basis of a new decision-making paradigm, as discussed by Turpin *et al*. (2009), based on Courtney (2001). In this research study the goal was to attain a variety of views on the research scenario in order to generate possible and varied solution options in terms of Key Sustainability Factor Enablers.

2.3.1 Motivational definition

The reason for selecting the Multiple Perspectives Approach was that the researcher perceives this approach as enabling one to carry out the research in a suitable instrumentalist manner; which implies the seeking of relationships as well as the addressing of known problems toward developing proposed solutions (Ducasse,

1941), as is the case with the goals pertaining to this study. This type of research is suited to the research problem and objectives because it addresses recognized problems in order to develop proposed solutions, as follows.

According to Singer (1959) and Churchman (1971), both within Mitroff & Linstone (1993: 92), and whose theories form the philosophical basis of the modern systems approach; the Multiple Perspectives Approach relates to systems thinking, and thus advocates the interconnectedness and inseparability of all systems or sciences, as all being fundamentally important. The systems approach states that all problems faced by humans are complicated and that this complexity should be recognised in order to create knowledge of complete systems as a whole (Mitroff & Linstone, 1993: 96). The specific context and consequences or purpose of the knowledge to be created, determine the complexity level of a given problem (Mitroff & Linstone, 1993: 95). *Open systems* are described as working together toward a specific objective, the outputs of one system serving as inputs to another, and being influenced by external factors (Daellenbach, 1994: 39). The present research problem is a case in point: the external environmental problem is faced by humans, the sustainability problem is of a complex nature due its environmental context and consequences, and the various systems function as an open whole and are inseparably involved in the form of the present research elements namely, ‘Organisations’, ‘Information Technology’ and 'South African SMMEs', within the environment as context.

The applicability of the Multiple Perspectives Approach to complex social problems in developing situations has been mentioned. To further support this statement, consider the concept of complexity more closely. Mitroff & Linstone (1993: 14) describe it in terms of a) unstructured problems which are on the cutting edge of knowledge and generally have no single, accepted or upfront way of being posed or

structured to the satisfaction of all authorities, and b) unbounded problems, which seem to have infinite numbers of solutions. When problems are both unstructured and unbounded they are most often social in nature and unbounded systems thinking becomes advisable as an analysis method (Mitroff & Linstone, 1993: 14). The present research problem fits into this theoretical frame in that it is a social system existing between the given research elements; the problem is unstructured and unbounded due to the high levels of uncertainty and disagreement of possible solutions aimed at ensuring sustainability of these elements; and the problem scenario resides within the context of South Africa as a developing country.

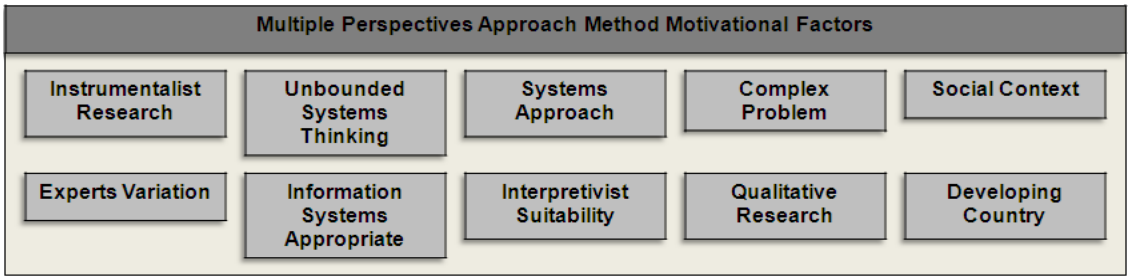
Its interpretive nature makes the Multiple Perspectives Approach appropriate for use in this research project. Mitroff & Linstone (1993: 97) state that within a complex system there is no way of working from completely outside it, to reach a purely objective output that will satisfy all parties (Mitroff & Linstone, 1993: 97); this implies a need for Interpretivist research. In turn Daellenbach (1994: 22) points to the interpretation of systems ideas as being necessary in studying the interactions of systems; as is done in this research to reach proposals for sustainability correlations between the research elements. Phahlamohlaka (2003: 109) also confirms the systemic grounds of interpretive rationality, implying that the systemic grounds on which the Multiple Perspectives Approach is based are appropriate.

Next, the Multiple Perspectives Approach is suited to research in the information systems domain, according to Turpin *et al.* (2009). Systems thinking offers important insight into the role of information systems (Checkland, 1999: 54).

Finally, the Multiple Perspectives Approach is utilised to collect the views - anticipated to be substantially varied - of representatives from differing domains of specialisation

within the green information technology industry. This holistic approach enables one most suitably to manage this qualitative knowledge creation process, in order to gain Key Sustainability Factors and their corresponding enablers for the research focus. Figure 2.2 provides a graphical representation of the Multiple Perspectives Approach motivators.

Figure 2.2: Method motivational factors



2.3.2 Theory

The Multiple Perspectives Approach was first introduced by Allison (1971), as discussed within Mitroff & Linstone (1993: 98), based on their book *Essence of Decision: Explaining the Cuban Missile Crisis* (Linstone, 1985: 77). This was initiated in terms of rational actor-, organisational process- and bureaucratic politics perspectives. Mitroff & Linstone (1993) have since elaborated on and qualified the method, commenting that it has developed into an accepted research approach under the name of Multiple Perspectives Approach.

The Multiple Perspectives Approach is a scheme of analysis, useful in developing various perspectives on different types of views (Courtney, 2001: 29-31) of complex systems, in order to understand a problem. Such insight into the nature of a problem

provides guidance toward possible solutions, and the opportunity to synthesise broad world views (Courtney, 2001: 29). Multiple Perspectives merged together form a Singerian inquiry system, according to Linstone (1985: 82), based on Churchman (1971). Such a system recognises the connectedness and irreducibility of aspects of complex problems (Courtney, 2001: 29) and takes human and environmental considerations into account (Courtney, 2001: 27).

The purpose of the Multiple Perspectives Approach is to grant consideration for human factors, other than only those of technical nature, via a holistic approach to the enquiry; in creating knowledge (Courtney, 2001: 30). This unbounded systems thinking is not governed by conventional logic and rationality, as it includes consideration for justice and fairness according to various social groups, as well as for the ethics of distinct persons (Mitroff & Linstone, 1993: 91). The viewpoints which constitute the Multiple Perspectives Approach, include the 'Technical' or 'T'-, the 'Organisational and Societal' or 'O'-, the 'Personal and Individual' or 'P'- (Bennets *et al*., 1999: 198), the 'Ethical' or 'E'- and the 'Aesthetic' or 'A' perspectives (Courtney, 2001: 29). Linstone (1999: 69) also more recently introduced the 'Mythology/Religion' or 'R' perspective, and also instituted the more widely recognisable terms of 'Organisational' and 'Personal' in referring to the 'O' and 'P' perspectives.

The method is attractive as it addresses three of Burrell & Morgan's (1979: 25-28) sociological paradigms, namely the functional, interpretive and radical humanist paradigms. It furthermore corresponds with Habermas' technical, practical and emancipatory interests. According to Turpin *et al*. (2009), the method also relates to several philosophical schools: the inductive–consensual approach of Locke, the analytic-deductive method of Leibniz, Kant's multiple realities and Hegel's dialectic.

2.3.3 Framework

Due to the evolution in knowledge about the Multiple Perspectives Approach since Allison introduced it, this study is based not on a single summary of the method; but instead on an inclusive framework of literature interpretations from a number of researchers in the field who have all still based their work on Mitroff & Linstone's (1993) ideas. This should give a more complete and suitable representation of the Multiple Perspectives Approach; on this basis the perspective types most suitable for the research scenario are selected for use. This requires recognition of the perspectives contained in the Multiple Perspectives Approach, in terms of their overall descriptions, world views and goals; enquiry modes, communications and perspective originators; and interpretation activities. Tables 2.1 and 2.2 set out the Multiple Perspectives Approach framework in terms of these parameters.

Table 2.1: Multiple Perspectives Approach perspective descriptions

Perspective	Description
Technical (T)	Reflects on scientific methods as in science and engineering, as a rational problem-solving approach (Mitroff & Linstone, 1993: 101). The dominant perspective, dealing with data, models, optimisation and alternatives. Effort is put into classifying, categorising, developing lists, tables, charts and graphs (Bennets *et al* ., 1999: 199).
Organisational (O)	The representation of subjective views of formal and informal groups (Turpin *et al.* , 2009). Concerned with policies, power and procedures internal and external to organisations, in responding to external- and reacting to internal pressures, in context of its culture (Bennets *et al* ., 1999: 199). A group or society as distinct entity in the eyes of its members; whom will sacrifice for the common good (Mitroff & Linstone, 1993: 102).
Personal (P)	Based on individual experiences, intuition, personality and risk (Courtney, 2001: 30). The representation of subjective views of formal and informal individuals (Turpin *et al* ., 2009). Includes any personal issues not covered by the T- and O perspectives. Deals with charisma, leadership and self-interest. Elucidates implicit and explicit power structures in an organisations (Bennets *et al.* , 1999: 199).
Ethical (E)	Concerns (Turpin *et al.* , 2009) based on spiritual and moral considerations of knowledge (Courtney, 2001: 22), including logic, rationality, abstract concepts, justice, fairness, individual values integrity, organist unity, religious texts and morals: according to the respective perspective type (Mitroff & Linstone, 1993: 100) (Linstone, 2003: 285) which it is regarded together with.
Aesthetic (A)	An artistic worldview, with the goals of harmony and artistry, being applicable to an interpretive mode of enquiry, and which is characteristically diverse, appreciating of beauty and seeking form and harmony (Hall *et al.*, 2002:4).
Mythology / Religion (R)	A holistic and subjective perspective focusing on spiritual, mythological and/or religious views of a system. May encompass the concept of personification (Jenkins, 2002).

Table 2.2: Multiple Perspectives Approach framework

Perspective	Technical (T)	Organisational (O)	Personal (P)	Ethical (E)	Aesthetic (A)	Mythology / Religion (R)
			Informational			
World View	• Science-technology (Mitroff & Linstone, 1993: 100) • Science or technology (Linstone, 2003: 285) • Mechanistic, analytical; man is rational, objective, thinking (Courtney, 2001: 29) • Scientific method and rational problem solving (Turpin *et al* ., 2009)	• Social entity, small to large, informal to formal (Mitroff & Linstone, 1993: 100) • Group or institution (Linstone, 2003: 285) • Group view justification goal (Courtney, 2001: 29)	• Individuation and the self (Mitroff & Linstone, 1993: 100) • Individual or self (Linstone, 2003: 285)	• Spiritual and moral considerations of knowledge (Courtney, 2001: 22)	Artistic worldview, seeking interpreted beauty (Hall *et al.*, 2002:4).	• God's creation (Linstone, 2003: 285)
Goal	• Problems solving and product (Mitroff & Linstone, 1993: 100) • Problem solving (Linstone, 2003: 285)	• Action, stability and process (Mitroff & Linstone, 1993: 100) • Action , process and stability (Linstone, 2003: 285) • Uncover stakeholder assumptions (Courtney, 2001: 29) • Attain formal and informal subjective views of as many role-players as possible (Turpin *et al* ., 2009)	• Power, influence and prestige (Linstone, 2003: 285) • Uncover stakeholder assumptions (Courtney, 2001: 29) • Attain formal and informal subjective views of as many role-players as possible (Turpin *et al* ., 2009)	• Actions of wisdom (Courtney, 2001: 22) • Uncover ethical issues (Turpin *et al* ., 2009)	Harmony and artistry (Hall *et al.* , 2002:4).	• Strong belief and belonging (Linstone, 2003: 285)

Execution						
Mode of Enquiry	• Observation, analysis, optimisation, modelling and cause and effect (Linstone, 2003: 285) • Interviews (Courtney, 2001: 29) • Influence or activity diagrams mapping of flows and processes of design and execution (Turpin *et al* ., 2009)	• Consensual, bargaining, satisfying, agenda and problem delegation (Linstone, 2003: 285) • Interviews, documentation, reports, questionnaires, articles and media (Turpin *et al* ., 2009)	• Intuition, learning, challenge and response and creativity (Linstone, 2003: 285) • Interviews, documentation, reports, questionnaires, articles and media (Turpin *et al.* , 2009)	• Critical systems approaches e.g. Ulrich's Critical Systems Heuristics (2003), Kass' (2001) Model, Total Systems Intervention (Flood & Jackson, 1991) (Turpin *et al.* , 2009) and various normative ethical theories	• Consideration in gathering other perspectives; appreciating beauty and seeking form and harmony (Hall *et al.* , 2002:4).	• Blind obedience, loyalty, de-individualisation, hatred of non-believers (Linstone, 2003: 285)
Communication	• Technical report or briefing (Linstone, 2003: 285)	• Public (Mitroff & Linstone, 1993: 100) • Insider language (Linstone, 2003: 285)	• Personality and charisma (Linstone, 2003: 285)	• Consideration in gathering other perspectives	• Consideration in gathering other perspectives	• Religious gatherings (Linstone, 2003: 285)
Creator	• Think-tank teams (Linstone, 2003: 285)	• Stakeholders (Linstone, 2003: 285)	• Individuals (Linstone, 2003: 285)	• Consideration in gathering other perspectives	• Consideration in gathering other perspectives	• Prophet or oracle (Linstone, 2003: 285)
Interpretation						
Analysis	• Reproducible analysis (Linstone, 2003: 285) • Interpret design flaws or problems, needs or missing functions; major role-players, processes, incidents, causes, effects and issues identified (Turpin *et al.* , 2009)	• Explicative value (Linstone, 2003: 285) • Interpretation (Courtney, 2001: 29) • Relation to T elements and positive or negative feelings or frustrations highlighted (Turpin *et al* ., 2009) • What is not said (Linstone, 1989: 327)	• Plausible image (Linstone, 2003: 285) • Interpret background, training, experience, values, ethics (Courtney, 2001: 30), common sense, feelings and thoughts (Courtney, 2001: 22) • Relation to T elements and positive or negative feelings or frustrations highlighted (Turpin *et al* ., 2009) • What is not said (Linstone, 1989: 327)	• Logic, rationality, abstract concepts of justice, fairness, individual values and morals: according to perspective type (Mitroff & Linstone, 1993: 100) • Logic, scientific rationality, integrity, organist unity, personal values, religious texts; according to perspective type (Linstone, 2003: 285) • Concerns (Turpin *et al* ., 2009)	• Interpretive toward goals of harmony and artistry; as ideals (Hall *et al.* , 2002:4).	• Meaning for person (Linstone, 2003: 285)

2.3.4 Intended application

Linstone (1989: 326) states that no phases, steps or formal procedures exist for executing the Multiple Perspectives Approach. The researcher will consequently conduct the empirical study in a logically progressive order, including the following activities and topics.

Mitroff & Linstone (1993: 99) indicate that a choice exists with regard to the perspectives to be included in studying a problem, based on the researchers' ethical values and implicit judgements. In the present research project, the perspectives 'Technical', 'Organisational' and 'Personal' were selected as main considerations toward gaining insights into the research problem and its possible solutions, while striving to attain a rich base for interpretation as well as a balanced analysis incorporating rational and humanistic thoughts (Mitroff & Linstone: 1993: 101). The combination of specifically these perspectives is furthermore suited to the socio-technological nature of this study in that the views of knowledgeable representatives are part of the process of gaining suitable knowledge; consequently the 'Aesthetic' perspective, regarding which little theory and an incomplete definition exists, is considered to be negligible. However, the 'Ethical' perspective is included in this study, explicitly only in the development of the 'Organisational' and 'Personal' perspectives, while it is irrelevant in studying the objectively-aimed 'Technical' perspective (Linstone, 1984: 78). The 'Mythology/Religion' perspective was considered but not included, due to its literal fundamentalist essence which opposes (Linstone, 2003: 385) the nature of the other selected perspectives.

With regard to data collection activities, Linstone (1989: 327) promotes interviews as playing a central role in successfully executing the Multiple Perspectives Approach.

That is where the interviews in the present investigation come in. In these, the interviewees were presented with the problem scenario as well as with the data from the literature survey, before being asked to reflect on this input and in response provide their individual perspectives. These lead to recommendations for the given Key Sustainability Factors of respectively the South African 'Environment', SMME 'Organisations' and 'Information Technology' elements. The goal of these interviews was to obtain between five and ten qualitative perspectives, intended to serve as mutually beneficial Key Sustainability Factor Enablers, as seen by each interviewee to be the most critical, with regard to the perspective in question. Each view qualified for submission as a valid Key Sustainability Factor Enabler if it adhered to a minimum of one Key Sustainability Factor per element; although multiple conformations were permitted and were regarded as superior inputs. In the data collection for the 'Organisational' and 'Personal' perspectives for the selected research perspectives, views were gathered in the form of quoted words or sentences, from interview responses. For instance, references to diagrams, regulations or articles were in turn gathered to gain 'Technical' perspectives. In addition, it was decided to include high-level consideration for the normative ethical theories, namely Relativism, Universalism, Consequentialism, Utilitarianism, Non-utilitarianism, Deontologicalism, Kantism and Egoism; in attaining and analysing views on the 'Ethical' perspective, as sub-concern during the carrying out of the 'Technical', 'Organisational' and 'Personal' perspectives. The manner in which these interviews were held followed Meltsner's (1984: 386) guidelines for executing the Multiple Perspectives Approach.

The output from this data collection phase served as input to the development of a conceptual framework composed of related factors to be considered in developing environment-friendly information technology policies within South African SMME organisations. This conceptual framework was based on the researcher's

interpretations of the set of Key Sustainability Factors, together with their various interviewee-recommended enabling recommendations for the respective elements themselves.

For the purposes of data collection, the researcher employed the software features of Skype version 4.1.0, together with the corresponding Skype Recorder package, for accurately recording the intended research interviews. With regard to the analysis and interpretation of the data collected on the selected perspective types, no software analysis tools were employed, since data interpretation took place by the researcher's individual mental model only.

However, thoughts based on the collected views were formulated in order to further develop the mutually beneficial relationship correlations in support of the suggested solutions to the problem scenario. They are based on the interpretational analysis parameters for consideration per perspective as set out in the summarised Multiple Perspectives Approach framework in section 2.3.3 of this chapter. The implementation process and the findings of the Multiple Perspectives Approach are further set out in chapter 4.

2.3.4.1 Directed Graphing application

In addition to the measures described in section 2.3.4 of this chapter, the Directed Graphing technique, as a method suitably relating to that of the Multiple Perspectives Approach, was added as a data analysis tool. This Directed Graphing was carried out with specific reference to the Hierarchical and Signed types of application, which is most applicable to the research context for combined analysis of the individual and overall systemic relationships and consequent strengths of the Multiple Perspective

views of environment-friendly information technology policies attained. The purpose of this was to propose a related and feasibly qualified set of policy recommendations, to be considered for implementation as environment-friendly information technology policies in South African SMMEs, via the conceptual framework developed from these interrelated views.

Presentation, motivation and development of the theory with regard to the Directed Graphing Method are contained in a separate chapter 5 for discussion in conjunction with the research activities.

2.4 Research standards

In this study the following research standards were followed. Maintaining rigour and relevance was important to the researcher, in assessing the value of the research contributions made during this work. Relevance and rigour were upheld throughout in the following ways:

- Relevance is implied by the motivation of this study having been instrumental in nature, and by the intention to have collected data qualitatively, but also all data which is readily available.
- Rigour is implied by the firm and thorough adherence to the research paradigm, approach and methods selected; by the independent nature of data analysis approaches utilised; and by the use of empirical data for analysis.

To ensure the validity of data utilised throughout this research, the following measures were taken:

- Literature sources were evaluated for their possible use in accordance with the specific research elements, within the study context; thus ensuring their relations

to appropriate domains and communities, for each specific research problem scenario.

- Theory on the research methods utilised was validated by selecting and applying knowledge as proposed by the original contributors of the theory.

In addition, data collection standards were upheld in this research study, as follows:

- All data collected were stored in secure physical and electronic archives, with backup procedures having been secured, toward creating an audit trail of all research data accumulated.
- The rights of research participants and informants were protected in conducting this study, by issuing descriptions and having informed consent forms signed.
- The type of relationship desired to be established between the researcher and informants, is that of a neutral stance, toward professional and relativistic interpretations of subject communications.

Finally, data analysis standards that were upheld as follows:

- The reduction of data to simplifying complex concepts (Oates, 2007: 185) was achieved via formally writing up field notes, thus enabling the revisiting of such scripts when needed.
- The reconstruction of data, toward building theory on integrated concepts, was achieved by applying the principles of the Multiple Perspectives Approach, as well as that of Directed Graphing theory, by having developed research element relationships, listing findings and deriving conclusions.

It was not anticipated that the research approach itself would evolve throughout the research project beyond what had been evaluated for use during the initial phases of the study. In retrospect, the research approach did not evolve to include further

approaches, but a section of a method that had been expected to be useful was actually excluded, namely that of Weighted Directed Graphing. This would have been an unnecessary data analysis activity, considering the data quantities collected.

3. Conclusion

The purpose of this second chapter was to establish and motivate a selected research approach that pertains to and builds on the research foundations and context set in chapter 1. This has primarily been achieved by introducing, theoretically discussing and delineating the intended application of Interpretivism as paradigm; by a literature survey based on accredited literature and documents found and by an empirical study based on interviews and field notes as data collection methods; by adopting the Multiple Perspectives Approach to the selected perspectives, namely, 'Technical', 'Organisational', 'Personal' and on a high level the 'Ethical', as main methodology; and by choosing the Directed Graphing Method - with details about it deferred to a later chapter - as data analysis tool. Finally, nine research standards, which the researcher aspires to apply throughout this study, have been described.

In the following chapter 3, the study progresses to the first part of the actual research work, in the form of a literature survey; via which data on Key Sustainability Factors for each of the described study elements are collected and analysed to provide an answer to the first of the secondary research questions.

CHAPTER 3

LITERATURE SURVEY:
TOWARD KEY SUSTAINABILITY FACTORS

1. Introduction

The purpose of this chapter is to collect and preliminarily analyse data via a literature survey, aiming at the identification of a set of Key Sustainability Factors for each of the study research elements, in providing an answer to the first of the secondary research questions, *"What key sustainability factors are respectively required in South Africa for a typical SMME organisation, the environment and information technology?"* (see chapter 1, section 5.2) as first step in carrying out this research project, based on the foundation and approaches set in the first two chapters. Such Key Sustainability Factors can be defined as being constituted of high-level critical goals that have to be achieved by green policy developers to ensure the mutually benefiting sustainability of information technology, the environment and the organisation in South African SMMEs. These data were obtained by qualitatively reviewing sufficient literature and documents, firstly on sustainability as an influencing concept mutual to all research elements and, having analysed these data, secondly in relation to the study context.

2. Sustainability as mutually influencing concept

In motivating this research (Webster & Watson, 2002: xv), the key concepts, 'Environment', 'Organisation', 'Information Technology' and sustainability, have been

described, together with corresponding alternative terminologies; for use during review and analysis in this literature survey. However, in pursuing the purpose of this literature survey - the identification of Key Sustainability Factors for the research elements, namely 'Environment', 'Organisation' and 'Information Technology' - it is necessary to elaborate on the definition of sustainability, the concept central (Webster & Watson, 2002: xiii) to all the elements. Viederman (1995: 10) describes sustainability as a vision of the future that provides us with a road map, and helps us focus our attention on a set of values, ethical and moral principles, by which to guide our actions. In addition, Fricker (1998: 371) states that a tendency exists to regard sustainability in environmental terms. This statement was found to be particularly pertinent to the present study; with an environmental focus being at the core of most literature when referring to sustainability in relation to any of the research elements. Also, as discussed in section 3.2.1 of chapter 1, economic sustainability also serves as a criterion specifically within the South African SMME context. In this scenario, the Key Sustainability Factors identified for each element via this literature survey relate to the respective elements as entities that may apply such principles within their individual subject areas, toward sustaining the environment and themselves. In turn, as such, the elements provide for a sustainability relationship among them all, as discussed in section 4 of chapter 1.

Considering this implication, information technology may be referred to as sustainable information technology for the purpose of gaining Key Sustainability Factors. A more appropriate industry term for this description would be "green IT". Similarly, sustainable organisations and a sustainable environment may be referred to as corporate greening and eco-friendly practices. The result of defining each research element in terms of sustainability is that of various types and levels of recommendations being advocated by the literature toward sustaining each element;

including strategic, procedural and technical criteria, among others. It is important to point out that the purpose of these Key Sustainability Factors is to provide information on what considerations should be taken into account in regard of sustainability per element, as conceptual categories which are only to be exploited to provide information on how to be executed, as is described in a later section. Subsequently, the Key Sustainability Factors identified via this literature survey were evaluated for their content of high-level criteria, achievable for each respective element; thus they serve as indicators on how each element can provide for sustainability.

3. Data collection

In executing this literature survey the researcher has adhered to and applied specific theoretical practices, set and complied with selected boundaries, utilised appropriately found sources and based all activities on a number of implicit values. These are next described.

3.1 Theoretical practice

In following an Interpretivist paradigm in this literature survey, attention was paid to the social context within which the research elements exist, by interpreting physical and social realities as understood in terms of social actors; by analysing scientific knowledge as understood from the perspectives of the individuals' subjective meanings and practices; and by viewing the relationship of the researcher as always implicating the research domain being studied; to enable the achievement of perspectives that may be differentiable. To outline the Key Sustainability Factors Induction was applied, by means of observing categories as naturally emerging to the

researcher from the respective elements' data. Subsequently, element sustainability data were gathered and analysed in a qualitative manner. Finally, the guidelines for executing a literature survey, as proposed by Webster & Watson (2002: xiii-xxiii), were adhered to, as indicated by references hereto being present throughout the survey.

3.2 Boundaries set

As boundaries to this literature survey (Webster & Watson, 2002: xv), an organisational unit of analysis has been followed in deriving information from the survey data; while the research time period studied covered only the most current South African situation, in terms of data based on laws and culture.. No boundaries were set on research regarding the environment or information technology, although sources were selected to represent the most recent views. The only geographical limitation pertaining to this study were the South African borders, with specific further selection of small-to-medium-and-micro enterprises (SMMEs) as the organisational size that was adhered to. Environmental and information technological data permitted to be considered for inclusion in this literature survey had no boundaries imposed on them, due to the universalist nature of environmental impacts. It must be emphasised that only Key Sustainability Factor data, as interpreted by the researcher to constitute the most critical considerations, have been included in this literature survey as alternatives. Furthermore, only literature sources directly pertaining to the research context, focus and element key concepts, have been considered for inclusion when collecting data.

3.3 Data sources

In pursuing this literature survey, a large number of textual sources (Webster & Watson, 2002: xv) were consulted to identify Key Sustainability Factors. For the research elements, 'Environment', 'Organisation' and 'Information Technology', the sources studied included, among others, governing South African and SMME laws, acts and standards, presentations, lectures, impact reports, corporate research results and leading theory. These sources occurred in the form of credible literature and documents found. Accredited literature found appropriate, credible and reliable for use included journal articles from leading journals (Webster & Watson, 2002: xvi) within the research domain, as well as books from leading contributors to the field. In turn, documents found suitable included relevant conference proceedings, postgraduate university lectures and white papers. Bias was averted in consulting sources that focused on individual discussions from the disparate lines of organisational, environmental and information-technological data, as well as of combinations of these fields, from which the researcher derived final views. In addition, ethical sources were consulted for the research topic area, and no preference was given to any specific research methods (Webster & Watson, 2002: xv) in reviewing information for suitability.

3.4 Implicit values

The values upon which the researcher based this literature survey, were rooted in the researcher's personal ethical base (Webster & Watson, 2002: xv) and mental model. According to these, key concepts (Webster & Watson, 2002: xv) were qualitatively identified and interpretively studied, to derive reasonable findings, in endeavouring to contribute knowledge about the factors that sustain the 'Environment' and

consequently maintain 'Organisations' and 'Information Technologies'. This literature survey, and in turn the whole research project, were primarily aimed at serving the interests of South African information technology green practice policy-makers, as a conceptual framework consisting of criteria to consider in developing mutually beneficial SMME standards. Consequently, the literature survey was only considered complete when no new concepts relating to Key Sustainability Factors were found, and considerations collected appeared to represent a relatively complete data sample (Webster & Watson, 2002: xvi). The following section discusses the data gathered to generate a Key Sustainability Factors list for each research element.

4. Data analysis

In analysing the accumulated qualifying data, as viable in terms of the definition of sustainability in section 2 of this chapter, this section discusses and interpretively reviews recommendations for Key Sustainability Factors, for the elements 'Environment', 'Information Technology' and 'Organisation', within the South African SMME context. The discussion is based on the stated literature sources and has as its aim the compilation of a qualitative Key Sustainability Factors list per element.

4.1 Environmental Key Sustainability Factors

After consulting various local and international environmental sustainability literature sources, including the South African Environmental Sustainability Index and the National Environmental Management Act, the principles as proposed by DesJardins (1998), Rosenberg *et al*. (1993), Olson (2008) and Fricker (1998) were found to correspond with the research focus of this study, as explicated below. When working on environmental sustainability, as defined within section 2 of this chapter, literature

propositions had to provide criteria according to which an environment could be classified as being sustainable. When one considers the mutually beneficial sustainability relationship between 'Environment', 'Organisations' and 'Information Technologies', as outlined in the scope of this research study, the environment will thus be sustained should both South African SMME organisations' practice and information technology applications comply with this set of environmental Key Sustainability Factors. Based on these literature requirements, the qualitatively evaluated and conforming environmental Key Sustainability Factors proposed, per author, are as represented in Table 3.1.

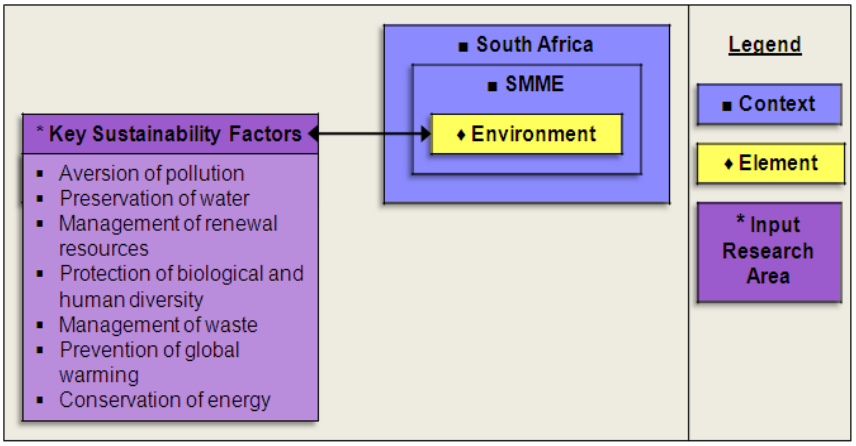
Table 3.1: Environmental Key Sustainability Factor propositions

Author	Key Sustainability Factors Suggested
DesJardins (1998: 829)	Avoided or minimal harm to the environment
Pearce & Morgan (1997: 2)	Protection of biological diversity
Rosenberg *et al.* (1993: 828)	Management of renewal resources
Olson (2008: 23)	Prevention of global warming
Fricker (1998: 371)	Protection of land, water and air Aversion of pollution Accommodation ability for population Preservation of water Conservation of energy Protection of human health Reduction of solid waste Recycling

Interpreting these proposed environmental Key Sustainability Factors toward a qualitative final list of principles, it was found that 'avoidance or minimizing of harm to the environment' as well as the 'protection of land, water and air' were too general as recommendations; and instead the more detailed relating and relevant recommendations 'aversion of pollution', which implies good air quality; 'preservation of water', which implies managed consumption (Fricker, 1998: 371); and 'management of renewal resources', which implies sustainable harvesting and

production and reduced consumption (Rosenberg *et al*., 1993: 828) were selected. A further theme was identified among the recommendations, namely 'protection of biological diversity', which implies the maintenance of populations, living organisms and ecosystems (Pearce & Morgan, 1997, 2), and that of the 'protection of human health'; and consequently these were classified as the 'protection of biological and human diversity'. Another theme is identified to be present among the recommendations, namely 'reduction of solid waste' and 'recycling'; which were categorised as 'management of waste'. The recommendation 'accommodation ability for population' was found to be irrelevant within the context of information technology and organizations able to sustain the environment, and was not selected as key factor. The two remaining recommendations, 'prevention of global warming', which implies the control of carbon emissions (Olson, 2008: 23); and 'conservation of energy', which implies efficient use (Fricker, 1998: 371), are both found imperative to this study as individual aspects contributing to the sustainability of the environment. Figure 3.1 provides the resulting graphical representation of the final qualitatively selected and interpreted list of principles of environmental Key Sustainability Factors, within context.

Figure 3.1: Environmental Key Sustainability Factors



4.2 South African SMMEs' Organisational Key Sustainability Factors

When reviewing various organisational sustainability literature sources, while working towards organisational sustainability as defined in section 2 of this chapter, with specific reference to the South African SMMEs context, it was not possible to allocate any literature suggestions that comply with both these research requirements. There were however references to a National Strategy for Sustainable Development being in progress for South Africa; which implicates the future provision of criteria for South African organisations to follow in undertaking sustainable business practices. However and consequently, for the purposes of this study, with organisational sustainability being based on the current South African scenario; the researcher logically derives a necessity for the application of data from the respective fields of non-geographically related organisational sustainability literature, combined with key economic goals for South African SMMEs, in order to achieve a list of organisational Key Sustainability Factors relevant to the research context. The last-mentioned compilation of economic goals is to serve as a further qualification measure for any global organisational Key Sustainability Factors. Accordingly, the next item to be discussed will be organisational Key Sustainability Factors and South African SMMEs' key economic goals as distinct entities, toward a consolidated view of South African SMMEs' organisational Key Sustainability Factors.

4.2.1 Organisational Key Sustainability Factors

When researching organisational sustainability literature, the principles as proposed by Winn & Angell (2000), Olson (2008), Starik & Rands (1995) and Jennings & Zandbergen (1995) were found to be the most valuable contributions. These literature propositions were evaluated for their serving the function of providing

criteria according to which organisations could be classified as sustainable with respect to the environment; while also, in regard of the mutually beneficial sustainability relationship between 'Environment', 'Organisations' and 'Information Technologies', organisations would in effect also be sustained, should organisational practice and information technology applications comply with these organisational Key Sustainability Factors as well as the previously discussed Key environmental Sustainability Factors. Based on these data requirements, the qualitatively evaluated and conforming organisational Key Sustainability Factors proposed are represented in table 3.2 for each author.

Table 3.2: Organisational Key Sustainability Factor propositions

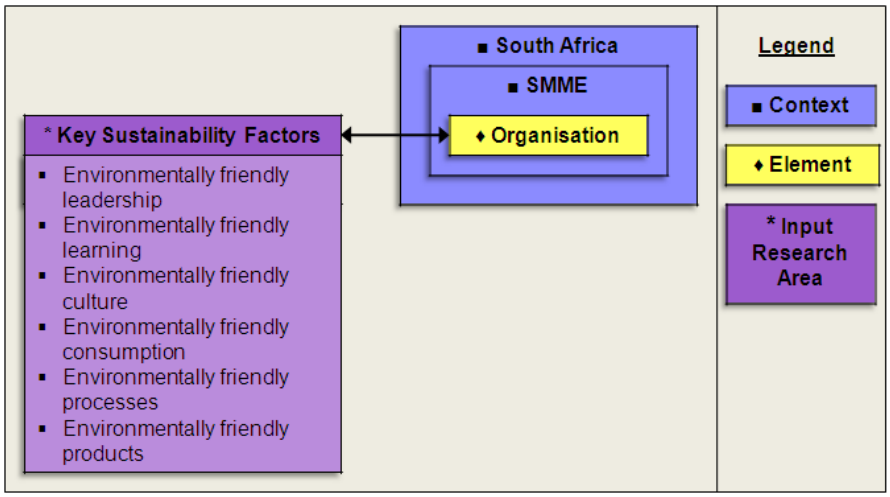
Author	Key Sustainability Factors Suggested
Winn & Angell (2000: 1129)	Environment considered in all functional decisions Environmental inputs and suppliers management Environmentally sustainable product designs
Olson (2008: 23)	Culture of environmental awareness Culture of proactive sustainable behaviour Conservational behaviour Green policies and initiatives
Starik & Rands (1995: 916)	Sustainable rates of natural resource inputs Processes designed for maximum conservation Sustainable goods and services development
Jennings & Zandbergen (1995: 1016-1120)	Ecological leadership Ecological learning Ecological organisational design Eco-efficiency Prevention of pollution Management of waste Management of environmental risk and liability

In interpreting these proposed organisational Key Sustainability Factors toward a qualitative final list of principles, the researcher identified a theme of green leadership among the recommendations, namely 'environment considered in all functional decisions', 'ecological leadership', 'management of environmental risk and liability' and 'green policies and initiatives' as policy referral. These recommendations were

classified as ‘environmentally friendly leadership’ as principal consideration, with references to decision-making, leading by example, risk management and policies are included. A next theme in the form of green learning was identified to exist among the recommendations of ‘ecological learning’ and ‘green policies and initiatives’ as initiatives referral. These were classified as ‘environment-friendly learning’, and found to be especially pertinent since the literature indicates little being known about internal corporate greening (Winn & Angell, 2000: 1119). The theme of green culture furthermore exists in the form of the recommendations ‘culture of environmental awareness’ and ‘culture of proactive sustainable behaviour’. These were decided to be a neglected but relevant topic in the literature, and classified as ‘environment-friendly culture’, with reference to pro-activity, awareness and behaviour which are included in them. A theme of green consumption was similarly identified via the recommendations ‘environmental inputs and suppliers management’ and ‘sustainable rates of natural resource inputs’. These were reclassified as ‘environment-friendly consumption’, which includes consideration for consumption with regard to organisational existence and production activities. The inclusion of green processes was evidently a major subject, since the recommendations ‘processes designed for maximum conservation’, ‘prevention of pollution’, ‘management of waste’, ‘eco-efficiency’ and ‘conservational behaviour’ all referred to it. These propositions were classified as the ‘environmentally friendly processes’ principle, to include references to waste, pollution, and efficiency. A final issue found to be key by the researcher was that of green products, represented by the recommendations ‘environmentally sustainable product designs’ and ‘sustainable goods and services’, of which the latter implies consideration for use, disposal and recycling of organisational products (Starik & Rands, 1995: 916). It was decided to classify these suggestions as ‘environment-friendly products’, to include regard sustainability for all phases of the product lifecycle. Figure 3.2 provides a graphical

representation of the final qualitatively selected and interpreted list of principles of organisational Key Sustainability Factors, in their context.

Figure 3.2: Organisational Key Sustainability Factors



4.2.2 South African SMMEs' Key Economic Goals

It is necessary to consider the key economic goals for South African SMMEs, in addition to Key Sustainability Factors for organisations; in an effort to relate the global organisational Key Sustainability Factors already discussed to those of the South African SMMEs context, as per the goals of this research. After a review of the guidelines of, among others, the National Small Business Act as well as those of the Small Enterprises Development Agency, the data of Labuschagne *et al.* (2005) and Makgoe (n.d), discussing South African goals for SMMEs development based on governmental plans, were found to be most relevant to the information technological context of this study. The goals described here represent governmental standards and are therefore fixed. They are hereby provided as key economic goals for South

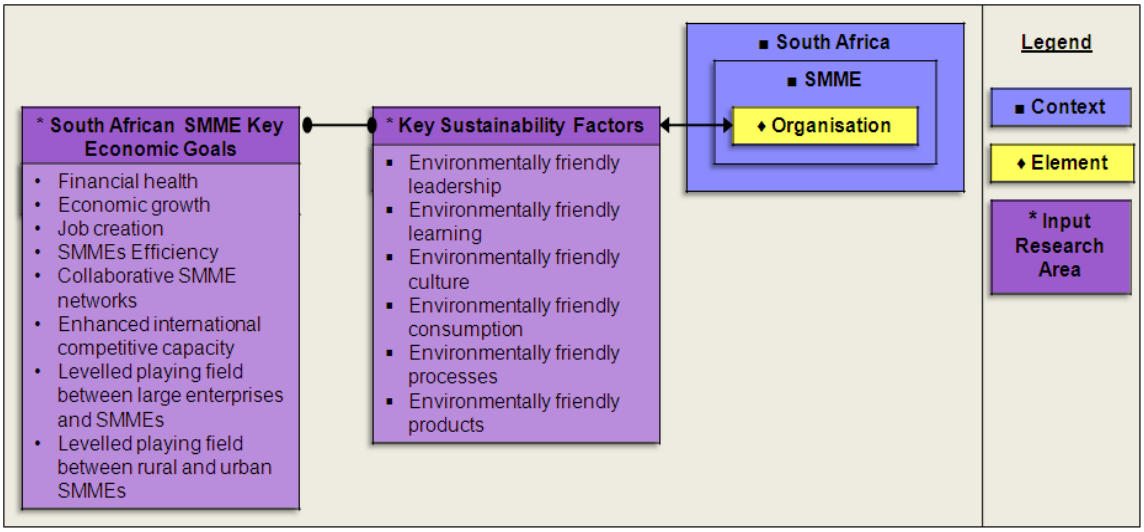
African SMMEs, to be related to the sustainability concept, and to be implied for SMMEs as individual organisations as well as collectives striving toward personal and combined organisational goals; as represented in table 3.3.

Table 3.3: South African SMMEs Key Economic Goal propositions

Author	Key Economic Goals Suggested
Labuschagne *et al*. (2005: 377)	Financial health
Makgoe (n.d: 5-16)	Economic growth Job creation SMMEs Efficiency Collaborative SMME networks Enhanced international competitive capacity Levelled playing field between large enterprises and SMMEs Levelled playing field between rural and urban SMMEs

Figure 3.3 provides the resulting graphical representation of the final qualitatively selected and interpreted list of South African SMMEs' organisational goals to be considered toward sustainability.

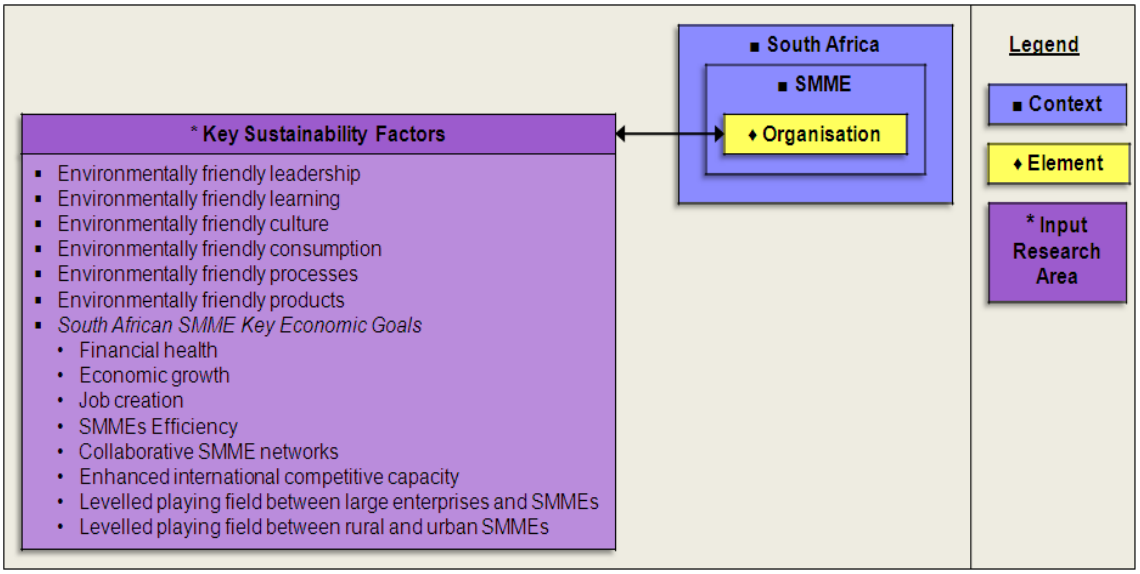
Figure 3.3: South African SMMEs' Key Economic Goals



4.2.3 Consolidation

Two lists were thus logically generated which respectively comprise geographically boundaryless organisational Key Sustainability Factors and South African SMMEs' key economic goals. It is necessary to combine these principles into one consolidated list of South African SMMEs' organisational Key Sustainability Factors. These are intended to function as a set of key criteria for sustainable South African SMME organisations, to be considered via the intended conceptual framework, and to guide green policy developers on an organisational level. The importance levels of the Key organisational Sustainability Factors and South African SMMEs' key economic goals have been interpreted as being equal, since the utilisation of pairs of considerations from both these groups is equally necessary in order to facilitate the accomplishment of organisational Key Sustainability Factors for South African SMMEs. It is consequently recommended that during environment-friendly policy development evaluations the South African SMMEs' key economic goals be considered as a separate but mandatory subset of considerations, to be regarded in conjunction with those of the organisational Key Sustainability Factors, thus relating them to each other in terms of policy qualification criteria. This approach ensures the incorporation of the South African SMMEs perspective into the development of globally recognisable organisational sustainability practice via environment-friendly information technology policy. Figure 3.4 provides a graphical representation of this related consolidation of considerations and goals toward a final list of South African SMMEs' organisational Key Sustainability Factors.

Figure 3.4: South African SMMEs' Organisational Key Sustainability Factors



4.3 Information-technological Key Sustainability Factors

On completion of reviewing various local and global information technology sustainability literature sources, including the ICT Sustainability Index and green IT research articles, it was found that the principles as proposed by the Shepherd University (n.d.), Murugesan (2008) and Pollack (2008) were appropriate to the research focus of this study. When working towards the realisation of information-technological sustainability, as defined in section 2 of this chapter, literature propositions had to serve the function of providing criteria according to which information technology might be classified as enabling sustainability of the environment. Simultaneously, in regarding the mutually beneficial sustainability relationship between 'Environment', 'Organisations' and 'Information Technologies'; information technology also had to be self-sustaining, should the organisational and information-technological practice comply with these information-technological Key

Sustainability Factors as well as with the identified Key environmental Sustainability Factors. The outcome and thus also purpose with this self-sustaining information-technological requirement is that of IT not only contributing to self-sustaining organisations, but also that of IT being applied toward environmental sustainability; thus sustaining human sustainability, which in turn promotes the sustainability of IT as a humanely applied function. Walsh's (2007) definition of green or sustainable IT as an all-encompassing term, used to describe the manufacturing, management, use and disposal of information technology in a way that minimizes damage to the environment, further clarifies this principle of consequent sustainability. The existence of information technologies within organisations, irrelevant of whether they occur as complete information technology firms or simply as departments within organisations with a non-information technological focus, implies a lower-level factorial relationship between that of organisations and information technologies, due to the connotation of information technology products representing practical implementations of organisational goals in terms of Key Sustainability Factors. The implication of this is that the Key Sustainability Factors proposed for information technologies are of a more detailed nature, although still on a conceptual scale; this tends to include technical and procedural criteria over those of conceptual or strategic recommendations. These qualitatively evaluated and requirements-conforming information-technological Key Sustainability Factors are represented in table 3.4, as proposed by each author.

Table 3.4: Information-technological Key Sustainability Factor propositions

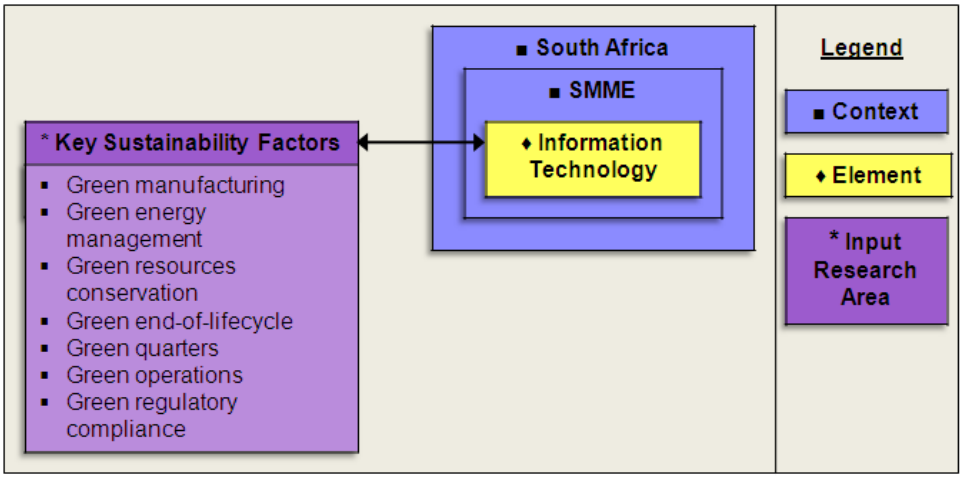
Author	Key Sustainability Factors Suggested
Shepherd University (n.d.)	Green computing, recycling, and waste management Green buildings Green software solutions Green operating policies, practices and procedures Biodegradable computer systems Energy efficient computer systems
Murugesan (2008: 26)	Green use, design, manufacturing and disposal Green strategy Energy-efficient computing Green data centre design Virtualization Green disposal and recycling or reuse or refurbishment Green regulatory compliance Green metrics, assessment tools and methodology Environment-related risk mitigation Renewable energy sources use Products eco-labelling
Pollack (2008)	Optimization of existing assets Reduced carbon omissions Power management Effective paper usage

In interpreting the proposed information-technological Key Sustainability Factors toward a final list of principles, it is found that all the recommendations are suited to the context of information-technology-promoting sustainability of the environment and information technology itself; but that a qualitative reclassification of ideas is necessary. It is proposed to regard the recommendations 'green metrics, assessment tools and methodology', 'green software solutions' and the manufacturing component of 'green use, design, manufacturing, and disposal' all as manufacturing considerations; they are thus classified as 'green manufacturing', to include regard for methods and measurements of the process and consequent products. Furthermore, the recommendations 'energy-efficient computing', 'energy-efficient computer systems', 'power management', 'virtualization' and 'reduced carbon emissions' are all found to be imperatives to the concept of energy; based on which they are classified as 'green energy management', including specific consideration for the ideas of efficiency, power management and carbon emissions. The

suggestions ‘effective paper usage’ and ‘renewable energy sources use’ are interpreted as both relating to protection and are consequently classified as ‘green resources conservation’, specifically including renewable resources and paperless environment aspects. A next grouping is evident through the mutual final product phase, which concerns the recommendations ‘green disposal and recycling or reuse or refurbishment’, ‘biodegradable computer systems’, ‘green computing, recycling, and waste management’, as well as the disposal consideration included in ‘green use, design, manufacturing and disposal’ and ‘optimization of existing assets’; the last-mentioned may also relate to efficiency concerns. These recommendations are found to be significant in considering environment-friendly information technology practice, and are consequently classified as ‘green end-of-lifecycle’, to include specific regard for optimization as opposed to disposal, as well as eco-friendly disposal. The primary idea of the next grouping concerns that of environment-friendly information technology accommodation, regarding the recommendations ‘green buildings’ and ‘green data centre design’. These are reclassified as ‘green quarters’, and include concern for the layout and location of organisational information technology production and utilisation areas (Murugesan, 2008: 26). A classification termed ‘green operations’ is considered necessary for grouping the management concerns ‘green strategy’, ‘environment-related risk mitigation’ and ‘green operating policies, practices and procedures’; the last of these includes regard for telecommuting (Shepherd University, n.d.). This consideration will specifically be analysed toward generating information-technological Key Sustainability Factor Enablers, when regarding the operations as being implemented and in effect; and not just as mere, possibly unutilized policies. Finally, a theme was identified in the nature of the recommendations ‘green regulatory compliance’ and ‘products eco-labelling’, the latter of which implies conformation to eco-friendly standards. These were consequently reclassified as a consideration entitled ‘green regulatory compliance’.

Similar to the previously identified considerations, this concern is also based on the actual adherence to and execution of regulations, and not only on attempts at doing so. Figure 3.5 provides a graphical representation of the final qualitatively selected and interpreted list of principles of information-technological Key Sustainability Factors, in their context.

Figure 3.5: Information-technological Key Sustainability Factors

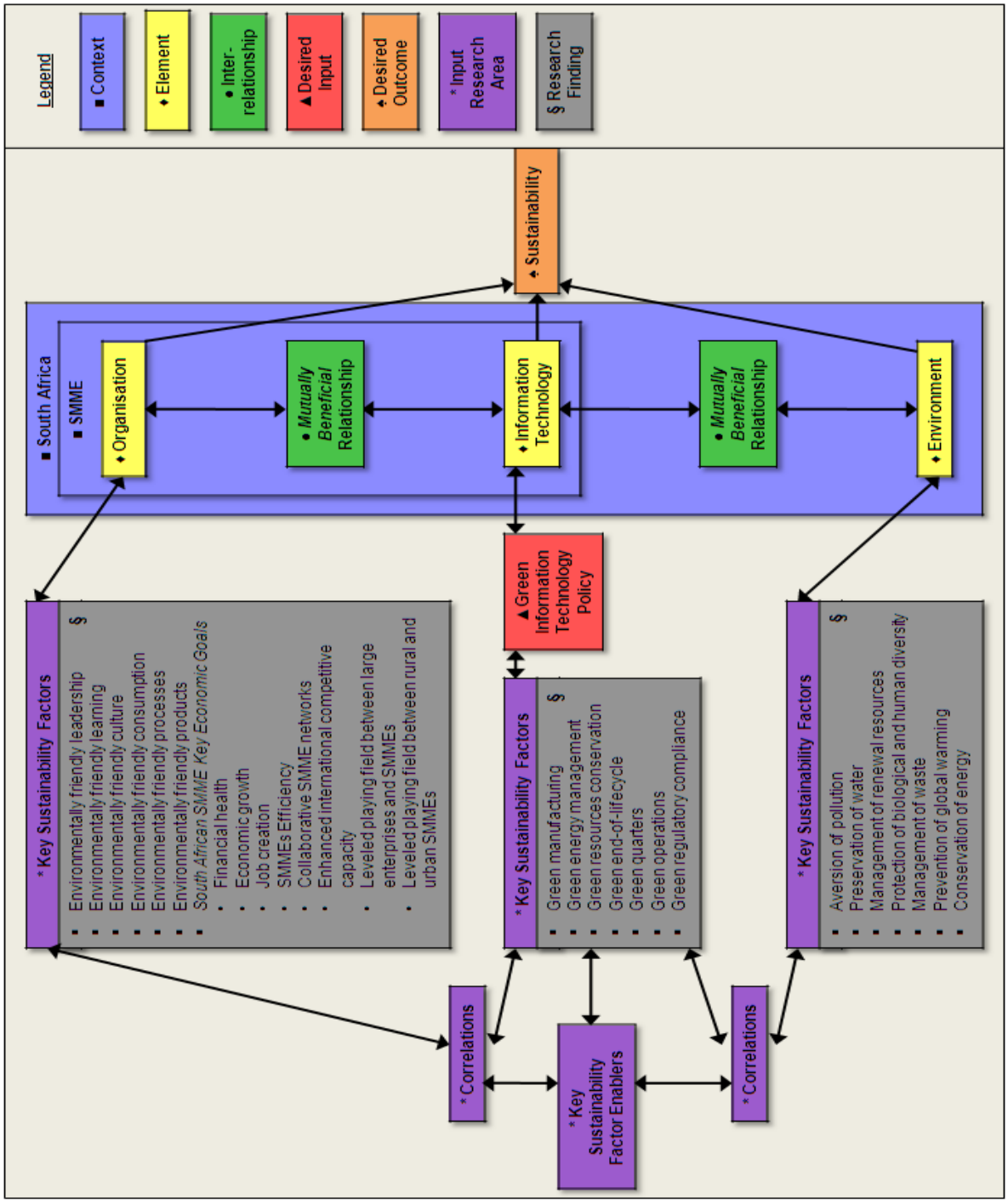


5. Data summation

In conducting this literature survey, a logical approach was followed to uncover, group and present key concepts in the form of recommended Key Sustainability Factors for each of the elements 'Environment', South African SMME 'Organisations' and 'Information Technology'; for these, literature data were extracted for each concept (Webster & Watson, 2002: xvii) into final qualitative Key Sustainability Factor lists. During this process key findings were indicated (Webster & Watson, 2002: xvii) by measurements of concept validity and by thematic grouping. An answer to the research question namely, *"What key sustainability factors are respectively required in*

South Africa for a typical SMME organisation, the environment, and information technology?" (see section 5.2 of chapter 1), was achieved in producing seven 'Environmental' Key Sustainability Factors; six 'Organisational' Key Sustainability Factors, to be regarded in conjunction with a factorial subset of eight South African SMMEs' key economic goals; and seven 'Information Technological' Key Sustainability Factors. These considerations may now be utilised toward gaining further insight into environmentally friendly information technology policies development, via the accumulation of Multiple Perspectives on practical implementations, recommended by industry experts; for the Key Sustainability Factors, in the form of Key Sustainability Factor Enablers, within in the next chapter of this research document. Figure 3.6 provides a summative graphical representation of the literature survey findings, represented within the original Research Focus Areas contextual figure discussed in chapter 1 point 5.1; in the form of a Key Sustainability Factors list for each of the respective elements (Webster & Watson, 2002: xvii).

Figure 3.6: Contextual Key Sustainability Factors consolidation



6. Conclusion

The purpose of this third chapter, namely 'Literature Survey: Toward Key Sustainability Factors', was to collect and interpret data toward the establishment of a set of Key Sustainability Factors for each of the research elements namely, 'Environment', 'Organisation' and 'Information Technology'; as high level critical goals to be achieved by green policy developers in ensuring mutually beneficial sustainability. This has primarily been achieved by, as a first step, elaborating on the concept of sustainability, as central aspect to all elements and providing for the existence of mutually sustainable relationships among themselves. Secondly, a literature survey, constituted of qualitatively reviewed literature and documents, toward consequently providing an answer to the first of the secondary research questions namely, *"What key sustainability factors are respectively required in South Africa for a typical SMME organisation, the environment, and information technology?",* was carried out. Research activities where based on the foundation and approaches as set within the preceding two chapters of this document. A contextually consolidated set consisting of seven 'Environmental', six 'Organisational', eight South African SMMEs' economic and seven 'Information Technology' Key Sustainability Factors, has been produced; to be utilised in verifying the intended conceptual framework's policy suggestions by, as being mutually sustainable.

Within chapter 4 to follow, this study builds on chapter 3's Key Sustainability Factors' establishment, by means of an empirical study; via which data on Key Sustainability Factor Enablers, being defined as policy recommendations toward mutually beneficial sustainability among the research elements, is collected and analysed. The Multiple Perspectives Approach, together with required fulfilling of certain Key Sustainability Factors, is applied toward answering the second secondary research question.

CHAPTER 4

EMPIRICAL STUDY:
TOWARD KEY SUSTAINABILITY FACTOR ENABLERS

1. Introduction

The purpose of this chapter is to take the research investigation further by means of collecting and preliminarily analysing data acquired via an empirical study, toward the identification of a number of Key Sustainability Factor Enablers, thus providing an answer to the second of the secondary research questions, *"How can the respective key sustainability factors of a typical SMME organisation and the environment be realised, in terms of information technology approaches that also adhere to the key sustainability factors of information technology, in South Africa?",* based on the foundation and approaches of chapters 1 and 2 as well as the Key Sustainability Factor data findings of chapter 3. For the purposes of this study, Key Sustainability Factor Enablers are defined as policy recommendations to be considered for implementation by green information technology practitioners, toward ensuring mutually beneficial sustainability of the research elements, 'Information Technology', 'Environment' and 'Organisations', within a South African SMME context. These Key Sustainability Factor Enablers were arrived at by consulting with suitably selected and profiled green information technology industry experts, via semi-structured interviews which were executed according to the Multiple Perspectives Approach for the selected 'Technical', 'Organisational', and 'Personal' perspective types, while also paying attention to the 'Ethical' perspective in applying normative ethical theories. In addition, an interviewing strategy, which included the Five Ws method as well as a requirement

for adherence to specific Key Sustainability Factors, ensured relevant data outputs, as applicable to the mutually beneficial sustainability research context.

2. Data collection

In executing this empirical study the researcher adhered to and applied specific theoretical practices, set and complied with selected boundaries, utilised appropriately found sources and based all activities on a number of implicit values. These are next described.

2.1 Multiple Perspectives Approach

The theoretical basis of the Multiple Perspectives Approach, according to which this study was executed, has been discussed in terms of its goals and procedures in chapter 2. The Multiple Perspectives Approach is suited to this research study due to its consideration for various viewpoints on singular complex problems, as is the case in regard of the mutually beneficial sustainability relationships among the research elements of this study: it also requires regard for aspects other than only technical ones. The rest of this chapter describes the practical execution and application of, and the driving intentions for, the Multiple Perspectives Approach as an empirical study methodology which is suited to the focus of this research project.

2.1.1 Theoretical practice

An attempt was made to maintain balance between research perspectives, in terms of the time spent on developing each (Linstone & Meltsner, 1984: 360), throughout the respective interviews and interpretations. Although timely investigation of the

subject area was achieved toward the meaningful development of perspectives (Linstone & Meltsner, 1984: 358), the time horizon of the study was set only to the present state of affairs (Linstone, 1984: 72), i.e. during the years of this research from 2009 to 2011. This was pointed out to interviewees as a requirement for valid Key Sustainability Factor Enabler inputs.

2.1.2 Multiple Perspectives facilitation

While collecting and in order to generate appropriate Key Sustainability Factor Enablers, the main high-level data collection requirement was for the attainment of the most critical recommendations: to serve as mutually beneficial, in creating environment-friendly information technology policies. To develop appropriate 'Technical', 'Organisational' and 'Personal' perspectives, a qualitative framework was developed which incorporates their core ideas for appropriate investigation, as well as the means for their application by which data are to be represented and developed, based on the goals and instructions of the Multiple Perspectives Approach. Table 4.1 provides a summary of these parameters, taking into account the respective literature requirements which were applied in the development of the 'Technical', 'Organisational' and 'Personal' perspectives.

Table 4.1: Multiple Perspectives facilitation parameters

Perspective	Input Required Guidelines	Input Representation Means
Technical	• Discuss perspective as it is (Clary & Wagner, 1984: 264). • Consider the alternatives (Clary & Wagner, 1984: 263). • Provide technical factors and considerations (Clary & Wagner, 1984: 265). • Explain perspectives in terms of costs of alternatives and benefits of recommendations (Clary & Wagner, 1984: 267). • Objectively propose what will be a best solution (Linstone, 1984: 70). • No consideration to be granted for personalities, reputations or vested interests (Clary et al., 1984: 398).	• Cost/benefit analysis related, repeatable, calculated or factual data (Clary et al., 1984: 398).
Organisational	• Describe the problem toward consequent solutions (Clary & Wagner, 1984: 263). • Provide an ethical orientation. • Motivate recommendations. • Recommend the best perspective for the organisation in question (Linstone, 1984: 70). • Base proposals on organisational capabilities and nature (Clary et al., 1984: 403). • Express beliefs, values and world-views as basis for perspectives (Meltsner, 1984: 385).	• Quotations and non-verbal communication analysis. • Recognise group capabilities and culture. .
Personal	• Describe the problem toward consequent solutions (Clary & Wagner, 1984: 263). • Explain driving factors and factors considered toward opinions (Clary & Wagner, 1984: 279). • Propose the best perspective for you personally (Linstone, 1984: 70). • Express individual beliefs, world views and motivations.	• Quotations and non-verbal communication analysis.

2.1.2.1 Incorporation of Ethical perspective

A decision was made to include regard for ethics into this study. According to Linstone (1984: 68), ethical regard can be incorporated in the 'Organisational' and 'Personal' perspectives, but not in the factual 'Technical' perspective. The researcher has considered the ethical bases of seven normative ethical theories,

namely Relativism, Universalism, Consequentialism, Utilitarianism, Deontologicalism, Kantism and Egoism, on a high level. These ethics descriptions where applied toward identifying and deriving ethical bases for each of the contributed 'Organisational' and 'Personal' perspective views, individually and as a whole per perspective; in order to develop and analyse the perspectives for their consequent integration. The data for each perspective view were interpreted within the context of this study, and an ethical inclination was assumed for each. The interviewees were asked to do the same, and this was taken into consideration. These ethical inclinations were applied to analyse each view in relation to all others. At the same time, a Directed Graphing approach was followed to integrate the data perspectives, in order to ascertain an implementation strategy and its feasibility for the specific combination of perspective views. Table 4.2 sets out the descriptive assumptions, on which each of these ethical theories are based.

Table 4.2: Ethical theories considered

	Theory	Ethical Assumption
a	**Relativism**	There is no absolute or universal right or wrong; judgments should be made relative to the environment in which it occurs (Graham, 2004: 3, 88).
b	**Universalism**	What is right is right for everyone, everywhere; and what is wrong is wrong for everyone, everywhere; a balancing of fairness (Parhizgar, 2002: 251).
c	**Consequentialism**	The consequence of one's judgement determines whether it was ethical or not, not the behaviour to achieve it in itself (Graham, 2004: 137).
d	**Utilitarianism**	Good judgement is any judgement that increases happiness; pleasure or happiness is the only absolute moral good (Graham, 2004: 137).
e	**Deontologicalism**	Views duties as absolute obligations that you must follow through with, regardless of consequences, personal feelings or inclinations (Parhizgar, 2002: 251).
f	**Kantism**	What's good for one is good for all; for a judgement to be morally right, one must will the judgement to be a universal law (Graham, 2004: 120-121).
g	**Egoism**	All people judge out of self-interest (Graham, 2004: 20-21).

2.2 Interviewing execution

The researcher has opted for the conduction of interviews as means of investigation toward gaining Multiple Perspectives, as discussed within chapter 2. The intended and executed application of interviewing, as empirical study method corresponding to the focus of this research endeavour, is herewith described.

2.2.1 Theoretical preparation

Interviewing practice, as recommended by Meltsner (1984: 382-390) for use in applying the Multiple Perspectives Approach, has been adhered to. In appropriately introducing and inviting interviewee candidates to participate, an establishing correspondence was presented to interview candidates and their respective organisations. This may be perused in Appendix A1, namely, Letter of Introduction. Accordingly, interview participants' anonymity was optionally preserved; as is evident from the Indemnity Form (Appendix A2). Interview participants were selected according to their suitable involvement within the time and concerns of the technology (Meltsner, 1984: 381) in question, namely environment-friendly information technology; of which further detail is provided in section 2.2.2 of this chapter. Intensive interviewing (Linstone & Meltsner, 1984: 363) was undertaken to obtain qualitative and detailed collections of data, as elaborated on in section 2.2.3 of this chapter. The perspective being used for each interview participant was also clearly explained while interviewing, as shown by Appendix A3, namely, Interview Preparation & Facilitation Documents. Ideas were aimed to be received rather than implanted by the researcher, by following a semi-structured interviewing style, together with an interview strategy discussed in section 2.2.3 of this chapter. The researcher aimed to maintain an empathetic approach during interviewing; to

promote a comfortable interviewing environment; and to facilitate confident information sharing by interviewees (Linstone, 1984: 75). The researcher aimed to employ thorough listening skills throughout, with special sensitivity to non-verbal communications, while endeavouring to collect as many data as possible. Finally, interviews were optionally voice-recorded, as is evidenced by Appendix A2, Indemnity Forms, and summarised immediately afterward (Linstone & Meltsner, 1984: 364) to ensure accurate record-keeping.

2.2.2 Selection of interviewees

In selecting interview participants, the first consideration was to follow the requirements for interviewees as described by Multiple Perspectives Approach theory. This calls for an inter-paradigmatic combination of professionals, insisted on in various inquiring systems as a pre-requisite, rather than an interdisciplinary grouping (Linstone & Meltsner, 1984: 358). Also, it requires that interview participants be selected based on who cares, has something to gain or lose, or has been involved within the scenario; toward selecting a representative sample, while still recognising their limitations (Meltsner, 1984: 381). Accordingly, the perspectives of interview participants were selected because they were all originating from the green information technology industry, but residing within different domains of specialisation within the industry, thus gaining suitably different perspectives on a function by which all are interrelated. It should be noted that these interviewees where not primarily selected on the basis of their representation within SMMEs, but rather because of their credibility with specific reference to the domain of green and sustainable information technology, and because of their specific roles within consulting and research organisations. This was expected to provide valuable insights from knowledgeable and experienced representatives of green and

sustainable information technologies, as pertaining to SMMEs and larger organisational types, as key concern. In turn, obtaining inputs from similar interviewees operating within SMMEs, as key concern, would probably have resulted in a collection of views of lesser objective and valuable nature, because such candidates would probably have had less exposure to the possibilities of the green and sustainable information technology domain outside the domain of their individual organisations. However, as secondary concern, it was considered a valuable proposition, although not minimum requirement, to include interviewees that also adhere to the mentioned primary concern, but also to that of being a representative functioning from within an SMME. Accordingly, two of the three participating interviewees, as delineated within section 3.1 of this chapter, have represented from within such SMMEs; specifically for the purposes of contributing views toward the 'Organisational' and 'Personal' perspectives.

Interviewing theory further necessitates the involvement of a different type of individual for each perspective type; for example, to represent the 'Technical' perspective, it needs technologists, scientists, engineers or analysts (Linstone, 1984: 70). The 'Organisational' perspective is said to be well represented by departmental heads (Linstone, 1984: 70), by those affecting organisational functioning (Meltsner, 1984: 385), and by individuals able to reflect on a particular organisational type's myths, modus operandi (Linstone & Meltsner, 1984: 361) and culture. The 'Personal' perspective in turn is represented by consulting staff (Linstone, 1984: 70), leaders, those who act outside organisational roles but affect outcomes (Linstone & Meltsner, 1984: 361), and those who can influentially support or oppose technology (Linstone & Meltsner, 1984: 365). Table 4.5, to follow within section 3.1 of this chapter, delineates how the selected interviewees correlate with these individual types; representing the three perspectives in question.

The context of this study was considered as a second aspect in the selection of interview participants. The technique used was to envision the user of the intended conceptual framework as a South African SMME corporate information technology executive, faced with the decision to develop a green information technology policy. This person would typically confer with a specialist products and-services consultation provider in the green or sustainable information technology industry; which would subsequently provide recommended views, including those of a technical, organisational and personal nature. Consequently, and because technical knowledge, deep understanding and experience were necessary for addressing the Key Sustainability Factor Enablers research question, it was decided to involve only experienced and knowledgeable green information technology participants in an interview, in order to derive information of value. In further incorporating the South African SMMEs context into the research results, only South African interview participants were involved. Also, they were asked to provide only Key Sustainability Factor Enabler recommendations which were available, utilised or feasible within South African organisations of SMME type.

When selecting individuals as interview participants in accordance with these requirements, a request was included to suggest several recommended views, per interview participant, per perspective, rather than requesting a singular recommendation from each of several interview participants. This way, detailed interviews with reputable individuals would lead to a high-quality data collection. Also, the research context and the information-technological nature of the recommendations sought are well suited to the gathering of multiple condensed views and to the socio-technical setting of the research problem.

2.2.3 Interviewing strategy

To achieve the goals of the Multiple Perspectives Approach (see chapter 2 and section 2.1.2 of this chapter), an interviewing strategy was created that was based on four of the six enquiry topics of the interrogative information-gathering Five Ws research method (Robertson, 1946: 11). Table 4.3 describes these strategic interview themes per topic, together with the semi-structured questions put to interview participants which were used to collect interview data.

Table 4.3: Semi-structured interview themes and questions

Topic	Semi-Structured Interview Theme	Questions
Who	Confirmation and establishment of interviewee credibility and suitability to the research endeavour.	• Explain your job title. • Describe the amount of years experience you have within this or a similar role. • Describe your qualifications, as relevant to the problem scenario, that you hold.
What	Provision of the recommended key sustainability factor enabling solution recommendations, by the interviewee.	• Describe the conceptual-, / strategic-, / technical-, / procedural-, / or product principle / focus area / characteristic / criteria which you recommend as a key sustainability factor enabling solution.
Where	Listing of the key sustainability factors, per element, to which the key sustainability factor enabling solutionative recommendations comply, toward achieving their validity.	• List the key sustainability factors, per element, to which the recommended key sustainability factor enabler, complies; with a minimum of one key sustainability factor per element being required for validity.
Why	Motivation and support for the proposed key sustainability factor enabler solution recommendations, to include specific reference to ethical bases, if suited to the perspective in question. The identification of political agendas.	• Explain why the recommended key sustainability factor enabler has been selected, in terms of its suitability as solution, based on the nature of the perspective in question. • Describe what ethical theory you have based this recommendation on.

The incorporation of this research method can be seen in Appendix A3, namely, Interview Preparation & Facilitation Documents; in which document section A relates to the first topic, while document section B does to that of the second, third and fourth

topics. The questions listed in the table have been structured so as to promote open-ended responses, allowing for further questioning in case interesting discussions or scenarios arise. These questions thus served as primary interview questions only, and could be supplemented with further semi-structured interview discussion themes. This was especially evident during the selection of mutually beneficial Key Sustainability Factors by interviewees, when these were being negotiated with the researcher, as will be described in section 2.2.3 of this chapter.

The procedure adopted to conduct the interviews began with the completion of indemnity forms by individuals who had agreed to participate. Appendix A2 contains this document. Next, over a period of three weeks, the interviews with each of the three participants were conducted in single intensive cycles of detailed interviews with each of participant, lasting approximately one- and a half hours each.

The interview participants were asked to prepare for their respective interviews, in an effort to promote the quality of their recommendations, and because the technical nature of the study was found to be sufficiently challenging so as to release certain interview question themes in advance of the actual interviews. Preparatory documents including information on the role of the interviewees and the research background, as well as setting out the general and specific requirements for recommendations to be provided, were supplied to the interview participants in advance for each perspective. Appendix A3, Interview Preparation & Facilitation Documents, provides examples for each of the perspectives' preparatory documents. It should be noted that these preparatory documents specifically exclude any mention of the final interview strategy theme and question, which were aimed at providing motivations for the recommendations made. This retained natural and non-verbal

communicative reactions from the interview participants, when they were unexpectedly being prompted - a most valuable source of data for interpretation.

From the interview sessions, interviewee input was qualitatively required in the form of information-technological recommendations for South African SMME decision-makers, with regard to setting up environment-friendly and sustainable information technology policies, in the form of suggested Key Sustainability Factor Enablers; as has been mentioned earlier. As far as the 'Technical' perspective is concerned, the resulting recommendations had to be of a purely objective and technical nature, without regard for organisational policies or personal opinions. For the purposes of developing an 'Organisational' perspective, recommendations had to be of a totally organisational and group nature, fitting in with the interviewee's organisation's point of view on the topic in question, and without regard for technical aspects or personal opinions. 'Personal' perspective recommendations in turn had to be of a totally personal and individual nature, in the sense that all recommendations had to reflect the personal opinions of the interviewee only; thus having no regard for technical aspects or the interviewee's organisation's views.

Further general requirements, pertaining to all three perspectives, were specifically that recommendations:

- of a minimum of five and maximum of ten in amount had to be proposed;
- relate to information technology as enabling means toward sustainability;
- regard any suggestions that can be translated into organisational information technology policy, for example, practices, products, services, strategies, procedures or standards; for example, in the form of principles, recommendations, focus areas, characteristics or criteria;

- represent those seen to be the most critical to the successful generation of environment-friendly and sustainable information technology policies; due to the scope of possible views that may have been submitted being so vast, in endeavouring the collection of qualitative data;
- relate to and be feasible to implement within South African SMMEs;
- constitute currently feasible and presently available propositions;
- not explicitly promote any specific product or brand solutions; but instead refer to functions or specifications sought after;
- comply with a minimum of one Key Sustainability Factor per element, selected from the identified and provided Key Sustainability Factors lists, so as to ensure mutually beneficial Key Sustainability Factor Enabler recommendations.

To this scenario, the identified South African SMMEs' key economic goals list of considerations was added as a fourth, separate and equivalent element to consider and comply with the suggesting recommendations. The Key Sustainability Factors were numbered accordingly, for easier reference in this document. Table 4.4 delineates the simplified four Key Sustainability Factor categories.

Table 4.4: Simplified Key Sustainability Factors reference table

	Environmental Sustainability Parameters
a	Aversion of pollution
b	Preservation of water
c	Management of renewal resources
d	Protection of biological and human diversity
e	Management of waste
f	Prevention of global warming
g	Conservation of energy

	Information Technology Sustainability
a	Green manufacturing
b	Green energy management
c	Green resources conservation
d	Green end-of-lifecycle
e	Green quarters
f	Green operations
g	Green regulatory compliance

	Organisational Sustainability Parameters
a	Environmentally friendly leadership
b	Environmentally friendly learning
c	Environmentally friendly culture
d	Environmentally friendly consumption
e	Environmentally friendly processes
f	Environmentally friendly products

	South African SMME Economic Goals
a	Financial health
b	Economic growth
c	Job creation
d	SMMEs Efficiency
e	Collaborative SMME networks
f	Enhanced international competitive capacity
g	Levelled playing field between large enterprises&SMMEs
h	Levelled playing field between rural&urban SMMEs

With regard to further specific 'Technical' perspective propositions, it was also required that:

- recommendations be supported via any one of the following means: data (classified, grouped, tabled, listed or graphed); models; optimisation theories; alternatives; comparisons; scientific proof; technical reports; briefings; cost-and-benefit analysis; cause-and-effect propositions; reports; diagrams; process flows; specifications; or logical reasoning.

Finally, in regarding both the 'Organisational' and 'Personal' perspectives' propositions, it was furthermore specifically required that:

- recommendations be each supported via an indication of the single most probable ethical basis upon which it was set by selection from a provided list which contained the seven normative ethical theories already chosen by the researcher as pertinent to this study (see section 2.1.2.1 of this chapter). These were discussed with and provided to the interview participants for consideration

in the tabular form, as shown n Appendix A3, Interview Preparation & Facilitation Documents, for each of the respective perspective types. The inputs from interviewees regarding these ethical bases were applied together with the researcher's interpretations and conclusions on the ethical bases being relevant per view, on a high level only; so as to interpret each view, perspective and all perspectives combined, in conjunction with an application of the Directed Graphing method as primary delineator, in integrating perspectives toward a feasible implementation scenario, as is set out within chapter 5.

Finally, the 'Organisational' and 'Personal' perspectives were distinguished between specifically in terms of the interview candidates selected for participation, each being from and representing either an organisational or personal point of view, due to their knowledge bases and roles within their organisations. This was described in section 2.2.2 of this chapter.

3. Data representation

The theoretical practices, selected boundaries, sources and implicit values according to which this empirical study was conducted have been described. The purpose of this section is to represent the Key Sustainability Factor Enablers together with the motivational concerns surrounding them, as recommended by the interview participants, as outputs of this data collection task, in a structured but raw data form. In doing so, data on both the profiles of the interview participants, and on their views, are of importance in representing a complete record of collected data via the Multiple Perspectives Approach, due to their complex and interconnected nature (see chapter 2). The interviewed participants are now introduced, where after their views are recorded.

3.1 Introduction of interview participants

Based on the considerations for interview participants' selection (see section 2.2.2 of this chapter), the researcher selected, herewith introduces and consequently indicates the suitability of the interviewed participants. Although all three interview participants agreed to be recognized for the purposes of this study, the researcher has elected to present only profiles but no identifying information, as the last-mentioned does not pertain to the scope of this research. Table 4.5 thus provides data regarding the credibility of the interview participants' credibility as far as this study is concerned.

Table 4.5: Profiles of interview participants

Perspective / Characteristic	Technical	Organisational	Personal
Industry	Green Information Technology	Green Information Technology	Green Information Technology
Key Domain(s)	• Technology • Research	• Operations • Management	• Consulting • Analyst
Organisation	Microsoft South Africa	Sustainable IT	Tree Organic Technology
Job Title	Windows Sustainable IT Lead	Founding Director	Managing Director
Years Experience in This / Similar Role	• 1.5 Years in role • Microsoft • 5+ Years • Technical Specialist • Enterprise Product Group Lead	• 10 Years • IBM • Consulting, Project Management, Finance, Management	• 10 Years • EnergyQuote • Special Projects, Busines Planning, Development Head
Pertaining Qualifications	• Self- and industry educated • Practical creative applications • Passion for area	• Self-educated • Understanding of consumerism • Practical creative applications • Passion for area	• Green IT Researcher • Sustainable Web Development • B.Com Marketing
Representing Role	• Academic • Sales • Specifications • Data • Consulting	• Products • Services • Sales • Strategy	• Practitioner • Implementer • Trainer

3.2 Interviewing record

In the following, tabular summations of the recommended 'Technical', 'Organisational' and 'Personal' perspectives are given, as expressed by the interview participants. They document the key views of each, accompanied by motivations. As such, these interviewees fulfilled the roles of research team members during the data collection part of this research study, by providing views qualified by the researcher's literature survey data, on policies to implement toward mutually beneficial sustainability of the research elements. As vested interest, these interviewees all

share a passion for the domain, and each mentioned their willingness to contribute to such studies, expecting no direct or personal benefits of it. The researcher has offered each interviewee a copy of this final research document, for possible future reference.

When regarding the respective perspective views, it may be necessary to refer to the Simplified Key Sustainability Factors Reference table, as set out in section 2.2.3 of this chapter, in order to appreciate the identified complying Key Sustainability Factors per Key Sustainability Factor Enabler. Each such recommended interviewee view implied the submission of an invaluable and mutually beneficial factor.

With regard to the 'Technical' perspective, it should be noted that the submitted data have been factually recorded as they were provided per view; focusing on the main idea surrounding each recommendation, in an objective nature and including substantiation for it.

The 'Organisational'- and 'Personal' perspectives' data were in turn recorded by referencing direct quotations, as indicated for each view. Clary & Wagner (1984: 287) advocate the use of quotations in collecting and analysing data for the two perspectives, as the form of expressions and the substance of statements are retained; thus reflecting perspectives with increased effectiveness. In addition, an 'Ethical' perspective, as delineated in chapter 2 and section 2.1.2.1 of this chapter, has also been warranted high level consideration in regarding the 'Organisational'- and 'Personal' perspectives, and is consequently recorded within the summative tables of each.

3.2.1 Technical perspective

Table 4.6: Technical perspective data representation

No.	Key Sustainability Factor Enabler / Recommendation	Complying Key Sustainability Factors	Supporting Means	Motivational Description
1	Corporate IT governance	• Environment: d; f • Information Technology: b; g • Organisational: a; d • South African SMME: g; h	• Regulation http://www.itgovernance.co.uk/king_iii_3.aspx http://www.itgovernance.co.uk/green-it.aspx	Follow regulations. Achieve control of tax, legal, energy and pricing statuses e.g. King 3.
2	Voice conferencing	• Environment: a; d; g • Information Technology: b; c • Organisational: c; d; e • South African SMME: d; e	• Logical Reasoning Reduced utilisation of travelling forms and -time implies decreased use of products and processes inducing carbon omissions and energy use, and increased time management and -control is also achieved.	Use IT to reduce energy and carbon, while increasing efficiency, through reduced travelling and trip planning e.g. via Skype.
3	Multifunction printing	• Environment: c; d • Information Technology: f • Organisational: c; d; e • South African SMME: a; d	• Regulation www.energystar.gov/ia/business/challenge/bygtw/HR_Toolkit_Leaders_presentation_FINAL.ppt	Manage consumption via printers via locking with passwords and reducing wasted paper e.g. be Energy Star compliant.
4	Qualitative desktops	• Environment: e; g • Information Technology: b; f • Organisational: b; c; d • South African SMME: a; d	• Regulation http://www.energystar.gov/index.cfm?fuseaction=find_a_product.ShowProductGroup&pgw_code=CO	Use multipoint- and terminal servers, which use little power, to decrease consumption; instead of having a desktop per person.
5	Recycling	• Environment: a; e • Information Technology: a; d • Organisational: c; d; e • South African SMME: c; e	• Logical Reasoning Commitment to appropriate waste disposal is fixed and accommodated for on purchasing of products.	Cradled purchases from recycling vendors, including consumable products, toward decreasing IT waste.
6	Software upgrades	• Environment: g • Information Technology: b; f • Organisational: d • South African SMME: d	• Regulation www.energystar.gov/.../downloads/computer/Desktop%20Platforms%20V5%20Draft2%20ITI%20Feedback.pdf	Newer operating system versions are more energy efficient than older products e.g. Apple vs. Microsoft.
7	Server room planning	• Environment: g • Information Technology: b; e • Organisational: b; d e • South African SMME: a; d	• Regulation www.energystar.gov/ia/products/downloads/MKhattar_Case_Study.pdf www.energystar.gov/index.cfm?c=sb_success.sb_successstories2008_johnsonbraund	Thorough design and layout could as much as half energy bills.

3.2.2 Organisational perspective

Table 4.7: Organisational perspective data representation

No.	Key Sustainability Factor Enabler / Recommendation	Complying Key Sustainability Factors	Ethical Base	Motivational Quotation
1	Green level measurements	• Environment: c; g • Information Technology: b; f • Organisational: d; f • South African SMME: d	Utilitarianism	"You always need to measure some sort of KPI's...before entering any technology…for cost, energy, Co2 omissions…e.g. in a data centre using virtualisation, understand the parameters to measuring your goals. IT professionals often change infrastructures but cannot measure to show the difference to the business...companies, before you do any green IT understand what you have in place first."
2	Environmental impact recognition	• Environment: c; d • Information Technology: a; f • Organisational: a; b; c • South African SMME: d	Utilitarianism	"Understand organisations' impact from a business perspective…that changes their focus…e.g. in financial services they can just optimise their IT environment to make a big impact..in an industry that isn't necessarily IT intensive they need to look at applying technologies toward efficiencies in e.g. manufacturing via e.g. smart grids."
3	Energy usage monitoring	• Environment: g • Information Technology: b; f • Organisational: d; e; f • South African SMME: d; g	Utilitarianism	"Understand where you are using energy within your IT service…typically most is consumed by monitors and servers..fit in power management solutions and adopt server virtualisation strategies."
4	Service life-cycle management	• Environment: a; d; e; g • Information Technology: a; b; d; g • Organisational: d; e; f • South African SMME: c; e; g	Utilitarianism	"Look at procuring Energy Star compliant equipment…compliancy around e-waste initiatives such as REACH, EPEAT. Dispose of your assets in an environmentally friendly manner which is compliant with the Waste Management Act."
5	Assets optimisation	• Environment: a; e • Information Technology: b; d • Organisational: b; d; e • South African SMME: a; e	Utilitarianism	"Optimise existing assets versus procuring new ones..the carbon intensity of new ones is massive, rather see how you can extend the life of your IT assets."
6	Equipment categories	• Environment: c; e • Information Technology: a; f • Organisational: d; e • South African SMME: g	Utilitarianism	"Notebooks are more environmentally friendly options than desktops."

3.2.3 Personal perspective

Table 4.8: Personal perspective data representation

No.	Key Sustainability Factor Enabler / Recommendation	Complying Key Sustainability Factors	Ethical Base	Motivational Quotation
1	Reduced paper trial	• Environment: c; d; e • Information Technology: c; f • Organisational: c; d; e • South African SMME: d; h	Consequentialism	"Communication electronically based...as opposed to printing it out."
2	Green web development	• Environment: f; g • Information Technology: b • Organisational: d; f • South African SMME: d; f	Consequentialism	"Blackle, which looks at using colours in web design, which reduces energy consumption…do a calculation on how much can be saved…if you set it as a home page for many pc's you can save quite a bit of energy."
3	Green IT office design	• Environment: g • Information Technology: e; f • Organisational: c; d • South African SMME: a; d	Relativism	"Power consumption at the office...look at how you get power to how you use power...typical things such as light bulbs, ventilation, management and monitoring of power in SMME's e.g. pc's power supply and not to keep them always on."
4	Green products	• Environment: d; g • Information Technology: a; b • Organisational: d; f • South African SMME: c; d; e	Consequentialism	"Software to manage procedures…that are labour intensive…by providing better methods that aid business operations...reducing waste in businesses…electronic processes to manage time, planning, end of term. Certainly look at automation and being screen-bound...the electronic nature creates energy efficiency."
5	Baselined IT	• Environment: c • Information Technology: b • Organisational: a; c; d • South African SMME: a; b; d	Relativism	"See the effect of energy usage decreases after green implementations; re-measure, re-adjust…report from a carbon perspective."

4. Data summation

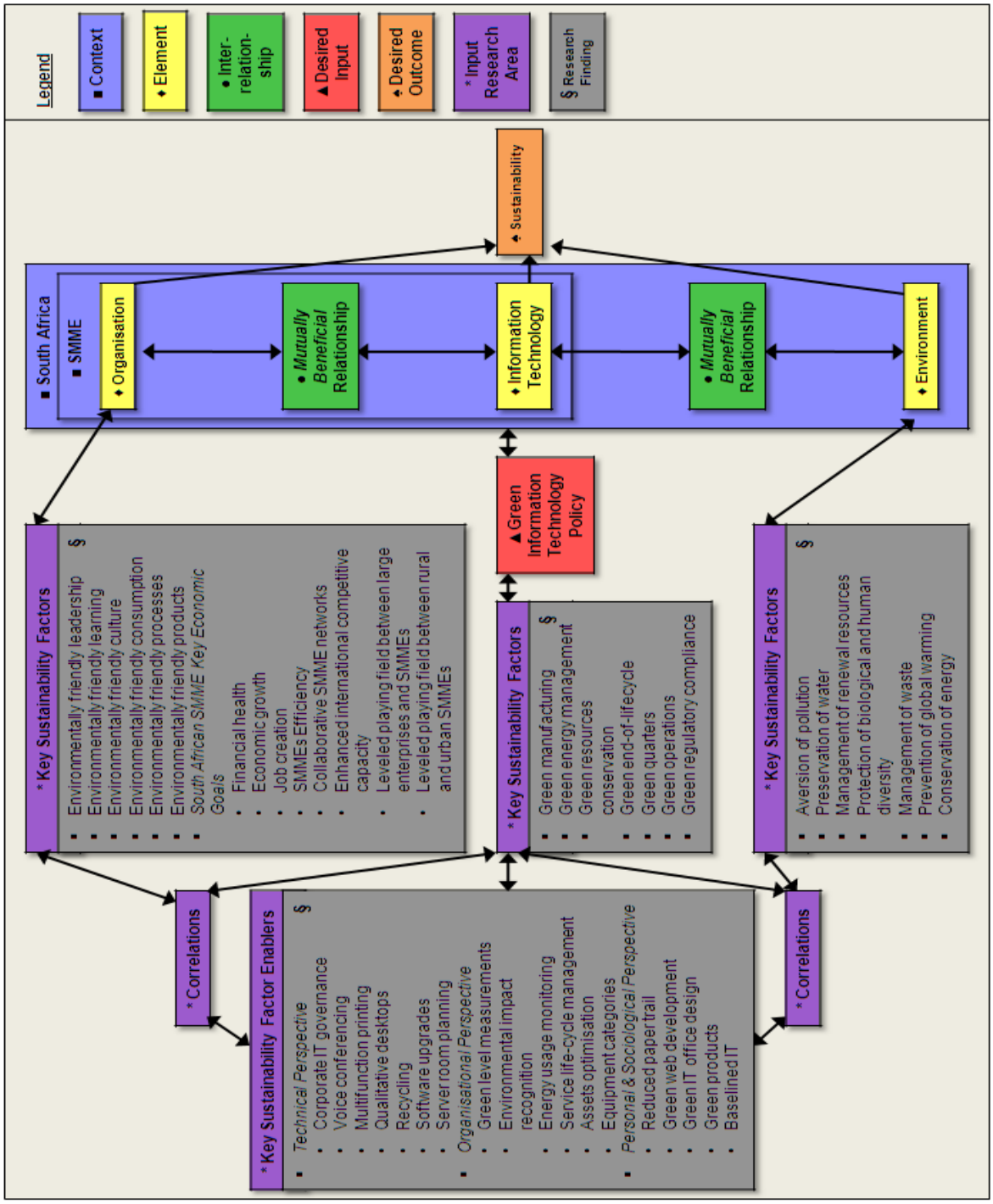
In conducting this empirical study, the Multiple Perspectives Approach was followed by accumulating the views of technically, organisationally and personally inclined green information technology experts toward the generation of respective mutually

beneficial Key Sustainability Factor Enablers. This process included the conduction of interviews, the application of normative ethical theories and the use of the Five Ws research method (Robertson, 1946: 11). Seven 'Technical', six 'Organisational' and five 'Personal' qualitative views were collected; the last two perspectives of which included regard for an 'Ethical' perspective, and for all of which the data have been represented in a structured but raw form.

However, in preparation for the analysis of these data in the next chapter, a contextually compiled view of it is necessary which relates to the status of this study. In order to achieve this, a single list of all the Key Sustainability Factor Enablers is next presented, within the original Research Focus Areas figure, discussed in chapter 1 section 5.1. This synthesis still provides for the origins of the respective perspective type as separate sets. According to Linstone (1984: 82), decision-makers will typically work from such a compilation toward self-integrating the views for practical application.

It must be noted that, in qualitatively compiling this list of Key Sustainability Factor Enablers, provision was made for the possibility of similar views consequently requiring to be combined or omitted. No such instances have been found as yet. Although certain views were identified as referring to similar topics, it was concluded that these relate to varied specifics within the topic areas, making all of them unique. Figure 4.1 provides a summative graphical representation of the overall and empirical study status, including the list of Key Sustainability Factor Enablers.

Figure 4.1: Contextual Key Sustainability Factor Enablers consolidation



5. Conclusion

The purpose of this fourth chapter was to collect and interpret data, via an empirical study, toward the establishment of a set of Key Sustainability Factor Enablers for each of the selected Multiple Perspectives Approach perspectives - 'Technical', 'Organisational', and 'Personal' - while also providing for 'Ethical'. These Key Sustainability Factors are to serve as policy recommendations to be considered for implementation by green information technology practitioners, so as to ensure mutually beneficial sustainability of the research elements, 'Information Technology', 'Environment' and 'Organisations', within a South African SMME context. Based on the foundation and approaches discussed in chapters 1 and 2, as well as on the Key Sustainability Factor data findings of chapter 3, the goal of the Key Sustainability Factor Enablers of this chapter has primarily been achieved by providing detail information on the applied data collection activities; by consulting with three suitably selected green information technology industry experts via semi-structured interviews of which an interviewing record was provided; by executing all according to the Multiple Perspectives Approach, the data from which are given as found, and which included the utilisation of seven normative ethical theories; by following an interviewing strategy, including the Five Ws method; and by requiring compliance with certain Key Sustainability Factors, toward ensuring the submission of policy views relevant to the mutually beneficial sustainability research scenario. As a result, an answer to the second of the secondary research questions, namely, "*How can the respective key sustainability factors of a typical SMME organisation and the environment be realised, in terms of information technology approaches that also adhere to the key sustainability factors of information technology, in South Africa?"*, followed; in the form of a contextually consolidated set of Key Sustainability Factor Enablers, consisting of seven 'Technical', six 'Organisational' and five 'Personal' policy views. The outcomes

of this chapter thus provide support for the existence of relationships, and of mutual benefit, among the research elements; in that certain Key Sustainability Factors of the three study elements are mutual among themselves as a result of various respectively pertaining Key Sustainability Factor Enabler combinations. It was furthermore also identified that, of the interviews' data collected, an inclination toward Utilitarian ethics dominated, with Consequentialism being second-most pertinent, for the views submitted; thus indicating purpose and outcomes as a result of views, as key ethical motivators in recommending them. More importantly, however, are the data factors that have been generated, in order to develop a resulting mutually beneficial and environment-friendly set of information technology policies, in the form of a feasibly implementable conceptual framework.

In the following chapter, this study builds on the establishment of Key Sustainability Factor Enablers' in the present chapter, by means of a data analysis and synthesis exercise aimed at the integration and relation of these views, to result in a prototyped conceptual framework for consideration in feasibly implementing these considerations, identified as being key to environment-friendly information technology policy. The Directed Graphing method is used, being applicable to the Multiple Perspectives Approach, thus further providing an overall systemic analysis of the Conceptual Policy Views set and an answer to the third and final of the secondary research questions.

CHAPTER 5

SYNTHESIS AND INTERPRETATION: TOWARD INTEGRATED CONCEPTUAL POLICY VIEWS

1. Introduction

This chapter qualitatively integrates the collected research data by means of the synthesis and interpretation of the identified Key Sustainability Factor Enabler views; via an application of the Directed Graphing Method, as applicable to the Multiple Perspectives Approach. The existence of mutually beneficial relationships among the contextual research elements has already been established; based on the set of Key Sustainability Factor Enablers produced and complying with the Key Sustainability Factors for all elements. This chapter consequently sets out to further produce a prototype correlation of these Key Sustainability Factor Enablers, now referred to as Conceptual Policy Views; as may have been achieved by typical green information technology policy developers, as input toward recommending a correlated conceptual framework option for implementation. An answer to the third and final secondary research question, *"How do the mutually beneficial key sustainability factor enablers, required in South Africa to respectively sustain a typical SMME organisation, the environment and information technology, correlate with each other?",* is thus anticipated by identifying and examining hierarchical levels and consequent relationships among Conceptual Policy Views in producing a Hierarchical Reachability Matrix, Iteration Matrices, a Signed Block Partitioned Reachability Matrix. As outputs, a Directed Graph and Hierarchical Polarisation will provide for an overall systemic analysis of the related Conceptual Policy Views set.

2. Prototype data analysis

In chapter 4 a Key Sustainability Factor Enablers list was produced. In addressing the research question just given for this chapter, it is necessary to further study the relationships between these Key Sustainability Factor Enablers; as related factors to be considered in developing environment-friendly information technology policies within South African SMME organisations. Such an analysis will serve as an interpretation of the data, toward producing an overall synthesised output.

Linstone & Meltsner (1984: 367) however recommend that the users or decision-makers of such data rather integrate such perspectives themselves, due to the distinctive grounds and understandings on which respective individuals may base their findings, resulting in different correlations of views toward different applications and conceptual framework prototypes by different users. In the event of such a prototype interpretation being performed, Linstone (1989: 328) recommends displaying the various perspectives, while still maintaining their individual integrity. As a result, a valid sample synthesis is achieved; which may however not be regarded as comprehensive or definitive (Linstone, 1984: 83). Consequently, the researcher in this chapter assumes the role of an analyst decision-maker, aiming to achieve the sampled and synthesised data interpretation just mentioned, in order to provide a suggested set of related conceptual framework factors to be followed in implementing an environment-friendly policy, as pertinent to this research project.

It should be noted that it was not an objective of this research study to have the resultant data analysis, data integration and conceptual framework verified by further external, knowledgeable research participants; the researcher has already relied heavily on input from external decision-makers in collecting the data; and opted to

carry out its analysis exclusively from the researcher's individual interpretive world view. It may however be a valid future research topic to have the data analysis exercise, which was here carried out by the researcher, executed by external representatives, to analyse the variances in interpretation and conclusions attained by respectively academic and practical interpreters.

2.1 Interpretive application strategy

Linstone (1984: 82), in regarding the analysis of perspectives attained via the Multiple Perspectives Approach, states that different policy developers will utilise different analysis techniques such as integration or summation, as no scientific method of integrating perspectives exists (Mitroff & Linstone, 1993: 106).

Consequently, various strategies were considered for analysing the data perspectives in question; including Wood-Harper & Fitzgerald's (1982: 13) data analysis approach for systems analysis, Checkland's (1981) CATWOE soft systems methodology (Feller & Fitzgerald, 2002: 51) for conceptual design, and "perspectives weighing" according to which potential users rank views based on set measures (Adelson *et al*.,1984: 315).

However, when considering the focal point of the intended data analysis as being the development and interpretation of correlations between respective perspective views of a complex system toward the development of a conceptual framework, as well as the goals of a typical perspectives analysis; an investigation of such individual views, together with their respective agendas and suitability levels, evidently becomes a requirement. Hall (1978: 114) furthermore describes the development of such complex systems models as the representation of cause and effect for decision-

makers' policy domains; with individual intuitive views of such domains possibly leading thought.

As a result, the researcher has identified Interpretive Structural Modelling, with specific reference to the Directed Graph or Digraph (Roberts & Brown, 1975: 577) application method, and applied to both Hierarchical and Signed Directed Graph conclusion types, as the most appropriate approach to be utilised for the purposes of this data analysis. A definition of and motivation toward the use of this application method follows.

2.1.1 Directed Graphing defined

Interpretive Structural Modelling was introduced by Warfield (1973: 441-444) and is suggested for use in applying practical experience and knowledge together with systems thinking, to deconstruct complex systems into ordered subsystems at multiple levels (Malone, 1975: 397). Elements and contextual relations are the fundamental concepts in executing the method (Iyer & Sagheer, 2010: 152).

Axelrod (1976: 55) introduced Directed Graphs as a form of cognitive mapping to represent a person's convictions about a set domain, such as a policy problem; designed to capture the structure of the person's causal assertions and to generate the consequences that follow from this structure. Directed Graphs are graphs in which labelled nodes represent variables, arcs represent relationships and directions between variables, while signs indicate influence of such relationships; thus representing the structure of a situation (Keys, 1991: 190). Directed Graphs assist in integrating knowledge about the values of decision makers and their causes and

effects thereof (Roos & Hall, 1980: 59). The value of its applications, lie within the depth and richness of such analyses (Adelson *et al*., 1984: 299).

A number of Directed Graph types exist, of which the researcher has specifically elected to utilise the two namely Hierarchical- and Signed Directed Graphs. Hierarchical Directed Graphs are produced from a form of analysis which produces layered representations of elements; indicating levels and reducing correlations toward simplified but complete versions. Signed Directed Graphs are in turn produced by allocating either a plus or minus sign to each element group's correlation (De Leon-Calio & Kuo, 2003: 69); as valuable considerations toward a specific scenario impacts (De Leon-Calio & Kuo, 2003: 70).

2.1.1.1 Research approach suitability

In regarding the suitability of Directed Graphs as analysis method for that of perspectives generated by the Multiple Perspectives Approach, Linstone states its use as being vital in synthesizing various insights into a coherent image, via the construction of reasoning as is present within decision-making (Adelson *et al*., 1984: 321); thus also relating to the problem-solving goals of the Multiple Perspectives Approach. Adelson *et al*. (1984: 321) further mentions this structural modelling technique as most suited to specifically indicating relationships between perspective views; thus correlating with the relationships focus of this analysis endeavour. Next, the method encourages the identification of consequences to decisions that may eliminate or enhance effects (Adelson *et al*., 1984: 321); which is a valuable trait toward considering goals and anticipating outcomes, as is associated with unbounded systems thinking; pertinent to both multiple views and environmentally friendly information technology policy formulation. Also, Directed Graphing is a

technically-orientated tool (Adelson *et al*., 1984: 321) for use by technically-trained analysts (Adelson *et al*., 1984: 327); thus correlating with the technical nature of this research, the researcher's knowledge base and the orientation of the Multiple Perspective views posed.

In applying the Directed Graphs Method toward analysing the relationships between Multiple Perspectives, the method furthermore correlates with that of the Interpretivism paradigm, in that the world view of the researcher impacts on the correlations analyses results.

Finally, in regarding the qualitative induction goal of this study, Keys (1991: 191) states that the Directed Graphs Method is, consequently suitably, qualitative in nature; as may be evidenced by the categorisation and natural groupings of perspective views' data during such analyses.

2.1.1.2 Research context suitability

The Directed Graph Method has been applied to a wide variety of disciplines, suitably including Operations Research and Social Sciences (De Leon-Calio & Kuo, 2003: 69); while the use of this method and this research's focus furthermore suitably correlates with the described goals of that of Jharkharia & Shankar's (2004: 701) information technology supply chain enablers ranking. Roberts & Brown (1975: 577) introduced the also comparable idea of studying environmental problems by means of Directed Graphs; as these require understanding of particularly complex systems, and involves many variables interacting with each other. Such causal loop diagrams, expressing how elements interact and influence each other (Jackson, 2000: 140), is valuable in analysing synergistic interaction between perspectives (Linstone &

Meltsner, 1984: 361); as an overall view of the options to be considered is attained (Roos & Hall, 1980: 70). The aims of such Directed Graphs are to analyse structure, investigate shape and examine changing patterns of structure and shape; toward identifying varying future implications (Roberts & Brown, 1975: 577), thus enabling figurative testing of outcomes anticipated in response to implementing specific sets of environmentally friendly information technology policy.

Decision-making usually concerns the integration of input of usually varying perspectives (Linstone, 1984: 81); while Directed Graphs are ideal for use in policy decision-making cases of complex situations (Adelson *et al*., 1984: 327); as suited to the study goal of analysing the complex socio-technical relationships existing between varying perspectives, toward a decision on a conceptual framework. Furthermore, Signed Directed Graphs are said to represent mathematical versions of complex systems, with particular reference to immeasurable variables, as is often present within societal problems; however with precise conclusions still being within reach (Roberts & Brown, 1975: 579).

Finally, the researcher once more confirms an elected research focus shift from the traditional inclination to analyse specific perspective view contributions, to that of the systemic relations of such views; as is suitable toward determining the systemic levels and –stabilities of such sets of perspective view variables, toward their most advantageous combined utilisations. A Directed Graph application will for this research endeavour adequately produce a high level hierarchical representation of qualitative study results, in a format indicating the correlations of the respectively combined perspective views; should these Key Sustainability Factor Enablers be implemented as per such a prototyped synthesis within South African SMME organisations' environmentally friendly information technology policies.

3. Interpretation execution strategy

In analysing the collected data, the Directed Graph Method will be progressively applied as is suited to the primary research approach, namely the Multiple Perspectives Approach. The manner in which the Directed Graph Method has been executed for such purposes is next described, followed by a specific setting out of minor method customisations and motivations for it; in order to maximise its benefits in being applied to this research endeavour.

3.1 Multiple Perspectives Approach Directed Graphing execution

In regarding the Multiple Perspective views attained, as relating to a Directed Graph application, Hall (1978: 104) describes all influencing policy variables, goals or performance criteria that are aimed for as well as relating causes and effects, as concept variables, which are represented as points. Adelson *et al*. (1984: 321) furthermore describes perspectives as forming the elements of policy. The Directed Graphing data analysis process pertaining to the Multiple Perspectives Approach is consequently carried out by means of Hierarchical Directed Graphing; in terms of a Reachability Matrix and Iterations Matrices, followed by Signed Directed Graphing in terms of a Block Partitioned Matrix and correlations analysis. The steps in executing such analysis, is next described.

3.1.1 Hierarchical Directed Graphing: Reachability Matrix

The goal of this process is to identify and indicate the relations between elements, in this instance relating to perspective views. In the event of multiple sets of elements existing, as is true of the various study perspective views, these, according to

Warfield (1973: 442), may be seen as subsystems; which can be compiled into a single renumbered set for analysis purposes. The contextual relationships between elements can consequently be identified in carrying out pair-wise comparisons of elements (Iyer & Sagheer, 2010: 154), in drawing up what is referred to as binary matrices of elements (Warfield, 1973: 441). Such matrices have immense use in the organisational phases of system modelling. Binary matrices represent the presence or absence of specific relationships between system elements; thus enabling the structuring of such systems (Warfield, 1973: 441). For the purposes of compiling a Reachability Matrix, such relationships may be described in terms of neutral influences existing between elements, being identified.

In setting up a Reachability Matrix, all elements are each listed in rows and columns. Should an influence or impact exist between any row and column elements combination, a '1' is recorded in acknowledging the relation; while a '0' is recorded to confirm the opposite. The element itself has to be included as base influence within each row and column combination (Iyer & Sagheer, 2010: 155). The output of this exercise being conducted for all row and column combination, is that of a Reachability Matrix; indicating all direct and indirect effects of an element on all other elements (Iyer & Sagheer, 2010: 154); thus indicating all relationships between system elements in binary form (Warfield, 1973: 441). The directionality of relationships can furthermore be derived, by associating vertical sets of correlations as originating from the vertical element in question, or similarly associating horizontal set of correlations as input toward the horizontal element, of the matrix (Warfield, 1973: 441). Directional relationships of elements relating back to themselves are often irrelevant in analysing Directed Graph systems, and may thus be excluded from graphical representations (Warfield, 1973: 441). In addition, the degree of the relationships between elements can be attained from a Reachability Matrix, in terms

of driving- and dependence powers; by totalling the columns and rows for each respective element. This provides understanding of individual element input dependencies and output element effects, as upheld through the relationships among elements (Iyer & Sagheer, 2010: 151).

The aim of this study is to combine views into a singular conceptual framework, which thus relates well to the aspects of binary systemic modelling, in order to investigate perspective views as a whole. Thus, no study is made of the interactions of the three perspectives as three subsystems within a whole. The elements are however studied in the form of various views, as equal but distinct contributors to a single system; toward the provision of a related views set and hierarchical environment-friendly conceptual framework of information technology.

3.1.2 Hierarchical Directed Graphing: Iteration Matrices

The goal of this next procedural step is the identification of feedback loops and categorisation of element levels by decomposing the related system of perspective views from its Reachability Matrix, so as to determine the hierarchies (Warfield, 1973: 444) of the pertinent perspective views. A consequent iteration matrix is thus partitioned by grouping reachability and antecedent sets per element, in order to determine intersections and consequent levels.

In compiling iteration matrices, the reachability of an element is defined as the set of elements, including itself, upon which the element has an impact; thus referencing the row of the Reachability Matrix for the specific element. Similarly, the antecedent set of an element is made up of the set of elements that have an impact on the current element; in turn referencing the column of the Reachability Matrix for the

specific element. Next, intersections are determined and confirmed by the reachability set of a specific element being a complete subset of its antecedent set. Such classifications indicate the presence of only feedback loops, or subsystems, between the originating elements and its intersection sets. Intersections are top-level sets of the Reachability Matrix; implicating progressive hierarchical top-level positions within a resulting Directed Graph (Warfield, 1973: 444). Jackson (2000: 140) advocates Forrester's (1968: 18) view of this notion and provides support for the classification of perspective view levels influencing overall policy strength; in describing a feedback loop as a structure within which a decision-point controls a flow or action stream, toward generating a system level. Consequently, intersections, as representations of complete sets of feedback connections to them, are removed from Hierarchical Iteration Matrices; by eliminating all references to them within all reachability- and antecendant sets as well as the element row itself (Warfield, 1973: 445). Such elements are next assigned a categorisation level; with the first iteration resulting in the highest level. This process is repeated for each iteration for the remaining reduced list of elements, until all elements are exhausted and their respective levels obtained. (Iyer & Sagheer, 2010: 151).

Within the present study it was established that the views of the respective three perspectives being studied, relate to each other. This makes the system transitive (Warfield, 1973: 444) and enables the use of a binary Reachability Matrix toward the identification of perspective view levels and relationships via the use of Iteration Matrices, as a most suitable application in determining levels of relationships among these anticipated policy views.

3.1.3 Signed Directed Graphing: Block-partitioned Directed Graph

The goals of this third step in the process of analysing perspective view relationships toward a prototype conceptual framework on environment-friendly information technology, are to graphically confirm the input and output elements of each element per hierarchical level, via block partitioning, as well as to graphically represent the complete identified set of conceptual contextual relations between all elements and their hierarchies, in the form of a Directed Graph, as derived by the Interpretive Structural Modelling process to date (Iyer & Sagheer, 2010: 156).

In carrying out block partitioning, an original Reachability Matrix is rearranged to reflect the hierarchical levels and relationship correlations as identified during a Hierarchical Iteration Matrices analysis. This is achieved by re-listing the elements vertically and horizontally in the order of their identified iteration levels; while indicating their antecedent relationship sets as at the time of elimination from the Hierarchical Iterations, vertically within the matrix via the entering of ‘1’s (Warfield, 1973: 445). Constituents are next indicated within the matrix, by outlining the smallest possible diagonal sub-matrix so that there are no ‘1’s to the right of the matrix. Hierarchies are similarly indicated by outlining the largest possible diagonal sub-matrix that is filled with ‘0’s and has no ‘1’s to the right; while excluding the main diagonal. Accordingly, each constituent result will as a minimum include the elements earlier identified for each hierarchical level; while elements on the same hierarchical level are listed in the matrix in order of least to most antecedent relation instances (Warfield, 1973: 446). The resultant relationships are hereby indicated for use in compiling a Directed Graph; with vertical correlations per element serving as inputs; while horizontal correlations, per element, indicate output relationships.

As output of this process, the respective Multiple Perspective views will be pictorially represented in terms of their influencing relationships existing among the views, as well as in terms of the hierarchical levels of dependency and influence existing between these views, in the form of a Directed Graph, thus displaying a prototype environment-friendly information technology policy implementation application.

3.1.4 Signed Directed Graphing: Polarised relationships analysis

The goal of this final step in the data analysis is to identify the polar orientations of the intersections of each element and the corresponding intersecting cycles, thus implicating an overall systemic status, as well as to reflect on these correlations. Such signing and consequent analyses of Directed Graphs focuses on cycles of arrows; which lead nodes to influence themselves and chains of nodes which may be controllable or not, thus increasing understanding of the origins and impacts of changes in node chains (Keys, 1991: 191). Controlling feedback loops are the key causes of a system's dynamic behaviour, according to Roos & Hall (1980: 53), based on Forrester (1968: 1-10).

In firstly assigning polarities to and analysing Directed Graph relationships, the execution of the method is based on the assumption that all effects take place in one unit of time without lag, and that all effects are equally strong (De Leon-Calio & Kuo, 2003: 70-71). Relationships between individual elements are represented by '+' and '-' signs (Adelson *et al*., 1984: 321). According to Hall (1978: 104) a plus sign denotes that an increase in the concept variable at the tail of the arrow will lead to an increase in the variable at the head; while a negative sign will indicate the opposite. Recursive feedback loops are also identified among elements, and are in turn analysed by summing the signs of correlation around each loop in the direction of

causality; consequently enabling the conclusion of a polarity for each loop as a whole (Roos & Hall, 1980: 62). Such a cycle is regarded as an overall positive, or as impact amplifying, when zero or and even number of negative signs are represented within it; while it is in turn considered as an overall negative, or as impact-counteracting, when an odd number of negative signs occur, according to Adelson *et al*. (1984: 323), based on Axelrod's (1976: 63) first rule. In addition, a positive feedback loop tends to reinforce changes in the values of loop elements; while a negative loop constrains changes and tends to restore systems to equilibrium (Roos & Hall, 1980: 62). In applying Directed Graph theory to policy applications, and as it is also suited to the application of the Multiple Perspectives Approach toward policy generation; positive relations reinforce the attitude toward or feasibility of policies, while negative relations counteract the attitude toward or feasibility of policies (Adelson *et al*., 1984: 321).

In complex systems, however, a vast number of relationship occurrences may become challenging to represent and analyse. Warfield (1973: 445) provides insight into accommodating such scenarios, in stating that symmetry applies to the relationships among elements of similar hierarchical levels, in that either no relations or two-way relations exist between such elements (Warfield, 1973: 444). Such mutually connected elements may instead represent their connections between Directed Graph levels, via any member of a hierarchical level, in a simplified form, by minimizing the number of connections per level, in opting to draw such constituents in a circular format; which will as such relevantly regard respective levels as isolated groupings in terms of their relationships (Warfield, 1973: 447). Within this study a Directed Graph is produced, according to which its hierarchy and feedback loops are graphically represented, in terms of perspective views and their relating influences. When identifying and analysing the relationship polarities and mutual feedback loops present between these perspective views, the chosen method was to apply Directed

Graph theory as per Warfield's (1973: 447) recommendation of circular level representations, in order to present a thorough and clear analysis of the complex and transitive system in question.

Secondly, when considering the analysis of the overall status of systems, the main focus is on determining system stabilities. According to Adelson *et al*. (1984: 323), based on Axelrod's (1976: 64) second rule, the total effect of one point on another point is equal to the sum of the indirect effects of all the cycles between such points. This implicates that, if obtained according to the previously mentioned recursive feedback loops analysis, the relationships of policy view loops are all of overall positive loop polarities, the overall system is deemed a determinate positive; if the relationships of policy view loops are all of overall negative loop polarities, the overall system is deemed a determinate negative; and if the relationships of policy view loops are of a combination of positive and negative overall loop polarities, the overall system is deemed indeterminate. This status consequently indicates the stability or instability of systems (Adelson *et al*., 1984: 326), since positive feedback systems often contribute to instability (Roberts & Brown, 1975: 579). Further deductions can be made based on this finding. Closed and physical systems usually seek stability and apprehend instability, while open human- or societal systems lead evolution and are consequently restless and seek change. In policy analysis and decision analysis, positive systemic instability in turn indicates agreement or strong support for decisions; while negative systemic stability implicates severe disagreement or suppression toward inaction (Adelson *et al*., 1984: 326).

By determining the stability status of a system an overall understanding is gained of the issues involved within it (Adelson *et al*., 1984: 294); in the present research project, this pertains to the strength of the specific combination of perspective views,

as a suggested policy to be implemented. In order to make a decision, thus relating to the development of a conceptual framework that will be in support of a specific policy views combination, a determinate outcome of the Directed Graph system depiction is necessary (Adelson *et al*.,1984: 323). Correspondingly, the purpose of such a system will not be for views to explicitly compete, but rather for the attainment of a coherent whole; based on relationships of a determinate nature, indicating more and lesser levels of views' importance, based on user interpretation. Table 5.1 depicts a summary of the discussed polarised relationships analysis outcome dimensions and options, which result from the interpretation and synthesis of the Multiple Perspective views, via a Directed Graphing strategy.

Table 5.1: Polarised relationships analysis outcome alternatives

Conceptual Policy View Correlations		
Positive	**Negative**	
Reinforces attitude / feasibility Tail increase induces head increase	Counteracts attitude / feasibility Tail decrease induces head decrease	
Loop Polarities		
Positive	**Negative**	
Zero / even number of negatives Impact amplifying Reinforces Conceptual Policy View changes	Odd number of negatives Impact counteracting Constrains Conceptual Policy View changes toward equilibrium	
Systemic Stability		
All Positive Loop Polarities	**All Negative Loop Polarities**	**Combination of Positive and Negative Loop Polarities**
Unstable system Determinant Open human / societal systems Strong support for decision / policy	Stable system Determinant Closed physical systems Serious split / suppression for inaction	Unstable system Interdeterminant Open / closed systems Indecision

3.2 Multiple Perspectives Approach Directed Graphing customisations

In constructing an analysed Directed Graph of the collected data for the perspective views, it is necessary, in addition to applying Directed Graphing theory, to also

incorporate consideration for the unique scenario pertaining to the context and execution of this research study.

Accordingly, with regard to the incorporation of data collected on the 'Ethical' perspective, it was decided to include the data in conjunction with those of each respectively corresponding 'Organisational' and 'Personal' view, in the same manner as they had been gathered together; toward analysis as a whole. In addition, since in this study each perspective is not represented by a different interviewee, as described in chapter 4 section 2.2.2, it was further decided to conduct the Directed Graph data analysis from the point of view of three different role-player types; as per the interviewee profiles described in chapter 4 section 3.1 which is applicable to the three pertaining perspective types, in order to represent the combined views per perspective as output. In this manner, views are still correctly analysed toward the goal of identifying their anticipated relationships, in generating a relevant prototype Directed Graph.

4. Synthesis representation

In presenting the Multiple Perspective views' data analysis and synthesis, based on the theory and applications introduced in this chapter, the establishment of two reference sets is found to be critical, in order to appropriately address both the respective perspective views as well as the Directed Graphing technique entities, via the pertaining graphically-restricted and highly specific methods execution.

Firstly, this is due to the physical limitations posed by binary and graphical data analysis via the Directed Graph Method, as a result of the complexities involved. Table 5.2 provides a reference table relating the view of each analysis perspective to

that of a numerical reference number. This implicates no other significance than that it can be utilised as such for the purposes and remainder of this research.

Table 5.2: Conceptual Policy Views reference numbers

	Reference Number						
Perspective	**1**	**2**	**3**	**4**	**5**	**6**	
• Organisational	Green level measurements	Environmental impact recognition	Energy usage monitoring	Service life-cycle management	Assets optimisation	Equipment categories	
■ Technical	**7**	**8**	**9**	**10**	**11**	**12**	**13**
	Corporate IT governance	Voice conferencing	Multifunction printing	Qualitative desktops	Recycling	Software upgrades	Server room planning
▲ Personal	**14**	**15**	**16**	**17**	**18**		
	Reduced paper trial	Green web development	Green IT office design	Green products	Baselined IT		

Secondly, due to the multitude of accepted terms relating to Directed Graphing that are in academic use, the individual elements concerned will respectively only be referred to as Conceptual Policy Views, intersections, relationships, loops, polarities, levels and systemic stabilities; the same applies to the remainder of this research. Table 5.3 lists this set of reference terms, together with the alternatives in naming conventions.

Table 5.3: Directed Graphing reference terms

Reference Term	Alternatively Utilised Terms
Conceptual Policy View	Element / Node / Point / Issue / Perspective / Variable / Value / Description / Cause / Effect
Relationship	Correlation / Influence / Effect / Arc
Intersection	Reachability-Antecedent Subsets
Loop	Cycle / Feedback / Chain of nodes / Controlling cycle / Cycle of arrows / Feedback loop / Subsystem
Polarity	Inclination / Tone
Level	Hierarchies / Categorisations
Systemic Stability	System

Based on the goals, instructions and interpretational analysis parameters set out in the discussed Multiple Perspectives Approach summary in table 2.2., and the theory

of Directed Graphing as analysis tool in this chapter; the findings of the corresponding results of these methods are next delineated.

4.1 Hierarchical Directed Graphing: Reachability Matrix

A binary Reachability Matrix, consisting of the pertaining Conceptual Policy Views in horizontal and vertical form, has been compiled, according to the delineations of section 3.1.1 of this chapter. Next, based on the researcher's interpretive world view, relationships have been indicated between these views; by inferring from the data of each row and column combination of Conceptual Policy Views, and acknowledging consequently perceived influences between by indicating '1' values as such, and '0' values in the event of the opposite. Table 5.4 sets out the complete Reachability Matrix, in terms of acknowledged and refuted relationships existing between perspective Conceptual Policy View combinations.

Table 5.4: Conceptual Policy Views Reachability Matrix

			Perspective Views																		
			Organisational						Technical							Personal					Dependance Power
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
Perspective Views	Organisational	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	3
		2	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	4
		3	1	0	1	1	0	0	0	0	1	1	0	1	1	0	1	1	0	0	9
		4	1	0	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	16
		5	1	0	1	0	1	1	0	1	1	1	0	1	1	0	0	0	0	0	9
		6	0	0	0	0	1	1	0	0	0	0	0	1	1	0	0	1	1	0	6
	Technical	7	1	1	0	1	1	0	1	0	0	0	1	0	1	0	0	0	0	1	8
		8	0	0	0	1	1	0	0	1	0	0	0	0	1	0	0	1	1	0	6
		9	0	0	1	0	1	1	0	0	1	0	0	0	1	1	0	1	0	0	7
		10	0	0	1	0	1	1	0	0	0	1	1	0	0	0	0	1	0	0	6
		11	0	1	0	1	1	0	1	0	0	0	1	0	1	0	0	1	1	0	8
		12	0	0	1	1	1	0	0	0	0	0	0	1	1	0	0	1	1	0	7
		13	0	0	1	1	1	1	1	0	0	0	1	1	1	0	1	1	1	0	11
	Personal	14	0	0	0	0	0	0	1	0	1	0	0	0	0	1	0	1	0	0	4
		15	1	0	1	1	0	0	0	0	0	0	0	0	0	0	1	1	1	0	6
		16	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	17
		17	0	0	1	1	0	0	0	0	0	0	1	1	1	1	0	1	1	0	8
		18	1	1	0	1	1	0	1	0	0	0	0	0	1	0	0	1	0	1	8
Driving Power			9	5	10	11	12	7	8	3	6	5	8	8	13	5	5	14	9	5	

The following conclusions were drawn from the resulting Reachability Matrix, based on Directed Graphing theory:

- As vertical sets of identified relationships serve as resultant inputs to the corresponding vertical Conceptual Policy Views, and horizontal sets of relationships similarly as outputs to horizontal Conceptual Policy Views, the comprehensive set of systemic input and output views per Conceptual Policy View, including consideration for feedback loops, can be traced via the

Reachability Matrix; but they are herewith also listed in terms of their assigned Conceptual Policy View reference numbers in table 5.5.

Table 5.5: Conceptual Policy View input and output relationships

Reference Number	Conceptual Policy View	Inputs	Outputs
1	Green Level Measurements	1, 2, 3, 4, 5, 7, 15, 16, 18	1, 7, 18
2	Environmental Impact Recognition	2, 7, 11, 16, 18	1, 2, 11, 18
3	Energy Usage Monitoring	3, 4, 5, 9, 10, 12, 13, 15, 16, 17	1, 3, 4, 9, 10, 12, 13, 15, 16
4	Service Life-Cycle Management	3, 4, 7, 8, 11, 12, 13, 15, 16, 17, 18	1, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18
5	Assets Optimisation	4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 16, 18	1, 3, 5, 6, 8, 9, 10, 12, 13
6	Equipment Categories	4, 5, 6, 9, 10, 13, 16	5, 6, 12, 13, 16, 17
7	Corporate IT Governance	1, 4, 7, 11, 13, 14, 16, 18	1, 2, 4, 5, 7, 11, 13, 18
8	Voice Conferencing	5, 8, 16	4, 5, 8, 13, 16, 17
9	Multifunction Printing	3, 4, 5, 9, 14, 16	3, 5, 6, 9, 13, 14, 16
10	Qualitative Desktops	3, 4, 5, 10, 16	3, 5, 6, 10, 11, 16
11	Recycling	2, 4, 7, 10, 11, 13, 16, 17	2, 4, 5, 7, 11, 13, 16, 17
12	Software Upgrades	3, 4, 5, 6, 12, 13, 16, 17	3, 4, 5, 12, 13, 16, 17
13	Server Room Planning	3, 4, 5, 6, 7, 8, 9, 11, 12, 13, 16, 17, 18	3, 4, 5, 6, 7, 11, 12, 13, 15, 16, 17
14	Reduced Paper Trail	4, 9, 14, 16, 17	7, 9, 14, 16
15	Green Web Development	3, 4, 13, 15, 16	1, 3, 4, 15, 16, 17
16	Green IT Office Design	3, 4, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17
17	Green Products	4, 6, 8, 11, 12, 13, 15, 16, 17	3, 4, 11, 12, 13, 14, 16, 17
18	Baselined IT	1, 2, 4, 7, 18	1, 2, 4, 5, 7, 13, 16, 18

- As is evident from the multitude of relationships listed above, the interpreted green information technology relationships mapping is in support of the transitive nature of this complex system.
- By summing the numbers of vertical inputs into respective Conceptual Policy Views, the degrees of relationships in terms of driving powers for each Conceptual Policy View can be derived. Similarly the degrees of dependence powers can be derived by totalling the horizontal numbers of output relationships

for each policy view. Accordingly, the Conceptual Policy views with the most-to-least input relationships with others, can be listed in terms of their assigned Conceptual Policy view reference numbers, together with their relationship quantities in brackets, as follows:

- 16 (14); 13 (13); 6 (12); 4 (11); 3 (10); 1 & 17 (9); 8, 11 & 12 (8); 6 (7); 9 (6); 2, 10, 14, 15 & 18 (5); 8 (3).

Similarly, the Conceptual Policy views with the most-to-least output relationships with others can be listed in terms of their assigned Conceptual Policy view reference numbers together with their relationship quantities in brackets, as follows:

- 16 (17); 4 (16); 13 (11); 3 & 5 (9); 6, 11, 17 & 18 (8); 9 & 12 (7); 6, 8, 10 & 15 (6); 2 & 14 (4); 1 (3).

It is interesting to note that the Conceptual Policy View of 'Green Web Development', a 'Personal' perspective type, has been identified to have both the most input and output relationships to other Conceptual Policy Views. This indicates a very high degree of relationships strength both for this Conceptual Policy View and that of the system as a whole, given the ratio of eighteen Conceptual Policy View relationships amounting to a strength of 100 %.

4.2 Hierarchical Directed Graphing: Iteration Matrices

A total of eleven Iteration Matrices, listing the pertinent Conceptual Policy Views together with their previously identified output relationships in terms of reachability sets, as well as similarly produced input relationships in terms of antecedent sets, have been compiled in identifying complete sets of reachability within each Conceptual Policy View's antecedent set, namely intersections. This has been executed according to the delineations of section 3.1.2 of this chapter. Such resulting

intersections are indications of feedback relationships existing between the respectively matching Conceptual Policy View sets; thus enabling the identification of levels of relationships existing, from most to least related, toward the development of a Hierarchical Directed Graph of relationships between the Conceptual Policy Views. Table 5.5 graphically represents the first and last Iterations Matrices, together with discussions of the results of those in between; with each Iteration Matrix's reachability- and antecedent sets, intersections and consequently produced hierarchical levels being indicated.

Table 5.6: Conceptual Policy Views Iterations Matrices

Iteration Matrix Level 1						
			Reachability (Outputs) Set	Antecendent (Inputs) Set	Intersections (Relationships)	Resultant Hierarchical Level
Perspective Views	O	1	1, 7, 18	1, 2, 3, 4, 5, 7, 15, 16, 18	1, 7, 18	1
		2	1, 2, 11, 18	2, 7, 11, 16, 18		
		3	1, 3, 4, 9, 10, 12, 13, 15, 16	3, 4, 5, 9, 10, 12, 13, 15, 16		
		4	1, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18	3, 4, 7, 8, 11, 12, 13, 15, 16, 17, 18		
		5	1, 3, 5, 6, 8, 9, 10, 12, 13	4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 16, 18		
		6	5, 6, 12, 13, 16, 17	4, 5, 6, 9, 10, 13, 16		
	T	7	1, 2, 4, 5, 7, 11, 13, 18	1, 4, 7, 11, 13, 14, 16, 18		
		8	4, 8, 13, 16, 17	5, 8, 16		
		9	3, 5, 6, 9, 13, 14, 16	3, 4, 5, 9, 14, 16		
		10	3, 5, 6, 10, 11, 16	3, 4, 5, 10, 16		
		11	2, 4, 5, 7, 11, 13, 16, 17	2, 4, 7, 10, 11, 13, 16, 17	2, 4, 5, 7, 11, 13, 16, 17	1
		12	3, 4, 5, 12, 13, 16, 17	3, 4, 5, 6, 12, 13, 16, 17	3, 4, 5, 12, 13, 16, 17	1
		13	4, 5, 6, 7, 11, 12, 13, 15, 16, 17	3, 4, 5, 6, 7, 8, 9, 11, 12, 13, 16, 17, 18		
	P	14	7, 9, 14, 16	4, 9, 14, 16, 17		
		15	1, 3, 4, 15, 16, 17	3, 4, 13, 15, 16		
		16	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17	3, 4, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18		
		17	3, 4, 11, 12, 13, 14, 16, 17	4, 8, 11, 12, 13, 15, 16, 17		
		18	1, 2, 4, 5, 7, 13, 16, 18	1, 2, 4, 7, 18		

- First Iteration: It is concluded that the output relationships of the Conceptual Policy Views numbered 1, 11 and 12, namely 'Green Level Measurements',

'Recycling' and 'Software Upgrades', match in full with that of their input relationships. These are consequently identified to represent the first hierarchical level of Conceptual Policy Views, thus having the most relationships and consequent requirements for policy implementation; and are removed from the Iterations Matrix toward identifying further intersections.

- Second Iteration: The output relationships of the Conceptual Policy Views numbered 2 and 3, namely 'Environmental Impact Recognition' and 'Energy Usage Monitoring', match in full with that of their input relationships. These are consequently identified to represent the second hierarchical level of Conceptual Policy Views, thus having the second most relationships and consequent requirements for policy implementation; and are removed from the Iterations Matrix toward identifying further intersections.
- Third Iteration: The output relationships of the Conceptual Policy View numbered 5, namely 'Assets Optimisation', matches in full with that of its input relationships. It is consequently identified to represent the third hierarchical level of Conceptual Policy Views, thus having the third most relationships and consequent requirements for policy implementation; and is removed from the Iterations Matrix toward identifying further intersections.
- Fourth Iteration: The output relationships of the Conceptual Policy View numbered 7, namely 'Corporate IT Governance', matches in full with that of its input relationships. It is consequently identified to represent the fourth hierarchical level of Conceptual Policy Views, thus having the fourth most relationships and consequent requirements for policy implementation; and is removed from the Iterations Matrix toward identifying further intersections.
- Fifth Iteration: The output relationships of the Conceptual Policy Views numbered 14 and 16, namely 'Reduced Paper Trail' and 'Green IT Office Design', match in full with that of their input relationships. These are

consequently identified to represent the fifth hierarchical level of Conceptual Policy Views, thus having the fifth most relationships and consequent requirements for policy implementation; and are removed from the Iterations Matrix toward identifying further intersections.

- Sixth Iteration: The output relationships of the Conceptual Policy View numbered 17, namely 'Green Products', matches in full with that of its input relationships. It is consequently identified to represent the sixth hierarchical level of Conceptual Policy Views, thus having the sixth most relationships and consequent requirements for policy implementation; and is removed from the Iterations Matrix toward identifying further intersections.
- Seventh Iteration: The output relationships of the Conceptual Policy Views numbered 6 and 15, namely 'Equipment Categories', 'Recycling' and 'Green Web Development', match in full with that of their input relationships. These are consequently identified to represent the seventh hierarchical level of Conceptual Policy Views, thus having the seventh most relationships and consequent requirements for policy implementation; and are removed from the Iterations Matrix toward identifying further intersections.
- Eighth Iteration: The output relationships of the Conceptual Policy Views numbered 10 and 13, namely 'Qualitative Desktops' and 'Server Room Planning', match in full with that of their input relationships. These are consequently identified to represent the eighth hierarchical level of Conceptual Policy Views, thus having the eighth most relationships and consequent requirements for policy implementation; and are removed from the Iterations Matrix toward identifying further intersections.
- Ninth Iteration: The output relationships of the Conceptual Policy Views numbered 9 and 18, namely 'Multifunction Printing' and 'Baselined IT', match in full with that of their input relationships. These are consequently identified to

represent the ninth hierarchical level of Conceptual Policy Views, thus having the ninth most relationships and consequent requirements for policy implementation; and are removed from the Iterations Matrix toward identifying further intersections.

- Tenth Iteration: The output relationships of the Conceptual Policy View numbered 4, namely 'Service Life-Cycle Management', matches in full with that of its input relationships. It is consequently identified to represent the tenth hierarchical level of Conceptual Policy Views, thus having the tenth most relationships and consequent requirements for policy implementation; and is removed from the Iterations Matrix toward identifying further intersections.

Iteration Matrix Level 11					
		Reachability (Outputs) Set	Antecendent (Inputs) Set	Intersections (Relationships)	Resultant Hierarchical Level
P.V	T	8	8	8	11

- Eleventh Iteration: It is concluded that the output relationships of the Conceptual Policy View numbered 8, namely 'Voice Conferencing', matches in full with that of its input relationships. It is consequently identified to represent the last hierarchical level of Conceptual Policy Views, thus having the least relationships and consequent requirements for policy implementation; toward representing a complete Directed Graph of the intersections identified.

The following conclusions can further be drawn from the resulting Iteration matrices, based on Directed Graphing theory:

- Of the eighteen Conceptual Policy Views analysed, the three with the most relationships - consequently implicating them as having the highest dependency on other Conceptual Policy Views being implemented to be implemented

themselves - are those numbered 1, 11 and 12; namely 'Green Level Measurements', an 'Organisational' perspective; 'Recycling', a 'Technical' perspective; and 'Software Upgrades', a 'Technical' perspective.

- Of the eighteen Conceptual Policy Views analysed, the three with the least relationships - consequently implicating them as having the lowest dependency on other Conceptual Policy Views being implemented to be implemented themselves - are, in order of least-to-most dependencies, those numbered 8, 4 and 9 and 18 being equal; namely 'Voice Conferencing', a 'Technical' perspective; 'Service Life-Cycle Management', an 'Organisational' perspective; and 'Multifunction Printing', a 'Technical' perspective and 'Baselined IT', a 'Personal' perspective.
- Next, the hierarchical levels of the analysed Conceptual Policy Views are summarised, in terms of most-to-least relationship dependencies, for consideration of the order of events to take place in implementing this specific combination of Conceptual Policy Views. Also, as feedback loop relationships exist between Conceptual Policy Views of similar levels, the following list also depicts which Conceptual Policy Views are related as such; and consequently what groupings of Conceptual Policy Views each contain an entity which will determine the ultimate systemic outcome regarding a decision for or against the implementation of any higher-level Conceptual Policy Views.
  - Level 1: 'Green Level Measurements', 'Recycling', 'Software Upgrades'
  - Level 2: 'Environmental Impact Recognition', 'Energy Usage Monitoring'
  - Level 3: 'Assets Optimisation'
  - Level 4: 'Corporate IT Governance'
  - Level 5: 'Reduced Paper Trail', 'Green IT Office Design'
  - Level 6: 'Green Products'
  - Level 7: 'Equipment Categories', 'Green Web Development'

- Level 8: ‘Qualitative Desktops’, ‘Server Room Planning’
- Level 9: ‘Multifunction Printing’, ‘Baselined IT’
- Level 10: ‘Service Life-Cycle Management’
- Level 11: ‘Voice Conferencing’

4.3 Signed Directed Graphing: Block partitioned Directed Graph

The next items to be presented are a block partitioned Reachability Matrix; a resulting Directed Graph, based on the set of Conceptual Policy View relations and hierarchical levels identified in section 4.2; and Directed Graphing theory as discussed in section 3.1.1 of this chapter. Accordingly, the block partitioned reachability matrix was produced by rearranging the original Reachability Matrix in order of least-to-most antecedent relation instances per level. The resultant diagonal sub-matrix was analysed and repartitioned to verify that no ‘1’s exist to the right of the diagonal matrix, indicating the constituents of the system; and that similarly no ‘0’s are excluded to its left, indicating the levels of the system. The hierarchical levels of the Conceptual Policy Views have accordingly been confirmed as per section 4.2 of this chapter, while the minimised input and output relationships, between levels, per Conceptual Policy View, have been identified. It must be noted that, in minimising the relationships set, feedback relationships to Conceptual Policy Views themselves are excluded. In addition, feedback loops occurring between Conceptual Policy Views of the same level - thus implicating that the same relationships exist for both Conceptual Policy Views - are only acknowledged via the Conceptual Policy View with the smallest intersection set, while still accommodating the relationships existing with both. Table 5.7 graphically represents the resultant block partitioned reachability matrix; with the red diagonal blocks indicating the levels of Conceptual Policy Views per row and columnar groupings, the resultant outer boundary regarding levels being

indicated by pink, and the finalised inner boundary regarding relationships being indicated by yellow. The final input and output relationships per Conceptual Policy View, toward a Directed Graphical representation, are thus as shown.

Table 5.7: Conceptual Policy Views block partitioned Reachability Matrix

Legend

● Organisational Views	▲ Technical Views	■ Personal and Sociological Views	♦ Levels	♠ Constituents	§ Repartitioned Levels & (Constituent) Relationships

Perspective Views																			
			●	▲	▲	●	●	●	▲	■	■	■	●	■	▲	▲	▲	■	●	▲
			1	12	11	2	3	5	7	14	16	17	6	15	10	13	9	18	4	8
Perspective Views	●	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	▲	12	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	▲	11	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	●	2	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	●	3	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	●	5	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	▲	7	1	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0
	■	14	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0
	■	16	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
	■	17	0	1	1	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0
	●	6	0	1	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0
	■	15	1	0	0	0	1	0	0	0	1	1	0	1	0	0	0	0	0	0
	▲	10	0	0	1	0	1	1	0	0	1	0	1	0	1	0	0	0	0	0
	▲	13	0	1	1	0	1	1	1	0	1	1	1	1	0	1	0	0	0	0
	▲	9	0	0	0	0	1	1	0	1	1	0	1	0	0	1	1	0	0	0
	■	18	1	0	0	1	0	1	1	0	1	0	0	0	0	1	0	1	0	0
	●	4	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0
	▲	8	0	0	0	0	0	1	0	0	1	1	0	0	0	1	0	0	1	1
																			♠	♦

It can be concluded from the block partitioned Reachability Matrix that all constituent relationships of hierarchies as well as all pertinent levels for the intended Directed Graph have been identified. This means that a minimised set of Conceptual Policy View relationships has been derived, as indication of their dependencies in implementing each respective Conceptual Policy View, based on this specific

interpreted combination. Directed Graphing display and further analysis of the system is now feasible.

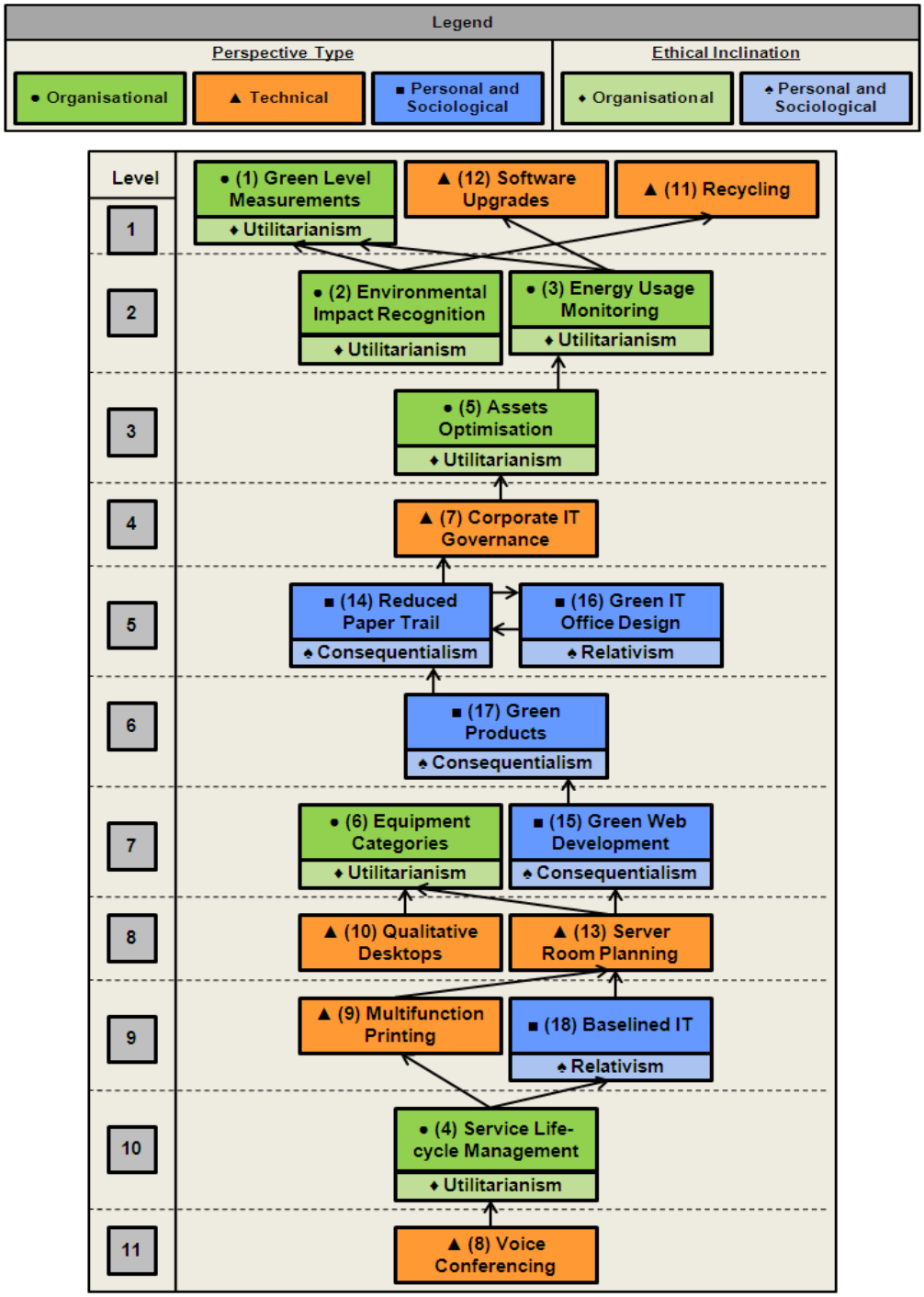
The minimised set of systemic input and output views, per Conceptual Policy View, is accordingly listed in table 5.8, in rearranged order of least-to-most intersections; in terms of their assigned Conceptual Policy View reference numbers.

Table 5.8: Minimised Conceptual Policy View input and output relationships

Reference Number	Conceptual Policy View	Inputs	Outputs
1	Green Level Measurements	2, 3	None
12	Software Upgrades	3	None
11	Recycling	2	None
2	Environmental Impact Recognition	None	1, 11
3	Energy Usage	5	1, 12
5	Assets Optimisation	7	3
7	Corporate IT Governance	14, 16	5
14	Reduced Paper Trail	16, 17	7, 16
16	Green IT Office Design	14, 17	7, 14
17	Green Products	15	14, 16
6	Equipment Categories	10, 13	None
15	Green Web	13	17
10	Qualitative Desktops	None	6
13	Server Room Planning	9, 18	6, 15
9	Multifunction Printing	4	13
18	Baselined IT	4	13
4	Service Life-Cycle Management	8	9, 18
8	Voice Conferencing	None	4

Subsequent to the before-mentioned findings in section 4.3 of this chapter, a concluding Directed Graph, indicating the confirmed hierarchical levels and input- and output relationships of the analysed Conceptual Policy Views combination, is graphically represented in figure 5.1, to delineate a prototype environment-friendly information technology policy conceptual framework.

Figure 5.1: Conceptual Policy Views Directed Graph



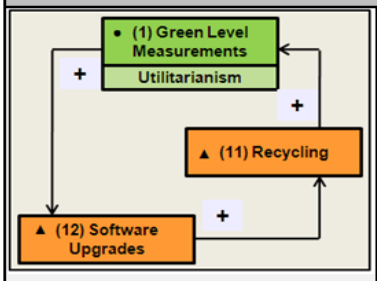
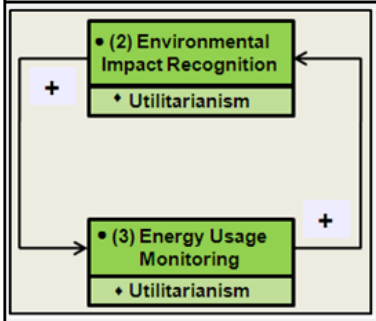
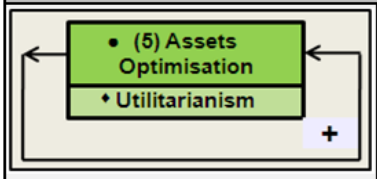
Further analysis and the listing of concluding findings, based on the produced Directed Graph, will be set out in section 4.4 in this chapter; as a result of the polarising and interpreting of the found Conceptual Policy View relationships, per level. Finally, overall systemic conclusions will be consequently reached and discussed.

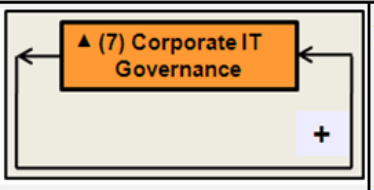
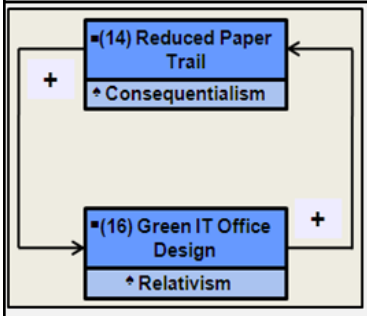
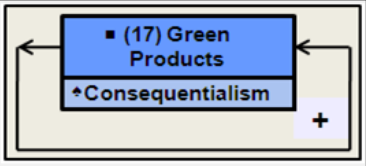
4.4 Signed Directed Graphing: Polarised relationships analysis

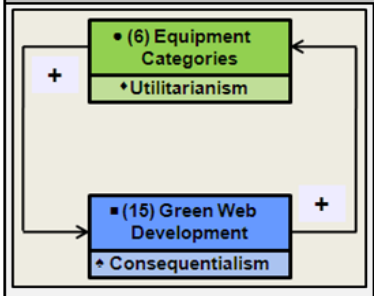
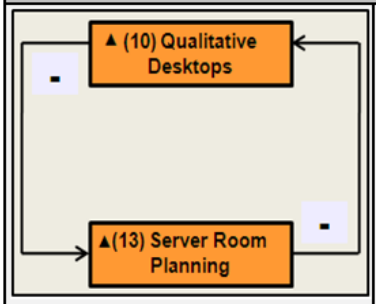
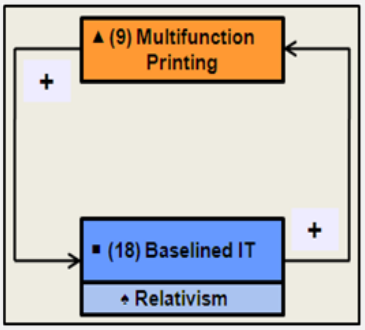
Based on Multiple Perspectives Approach theory and its intended application as delineated in chapter 2 section 2.3.4, as well as on the Directed Graphing theory of section 3.1.4 and the analyses findings of section 4.3 of this chapter; the polarities of the relationships existing between Conceptual Policy Views are next identified and reflected on, in terms of denotations and implications, and for each Directed Graph level. The findings of this analysis provide insight with regard to the specific Conceptual Policy Views, their roles as part of their respective systemic levels, and their contributions toward the system as a whole. Table 5.9 as such sets out the initial analyses.

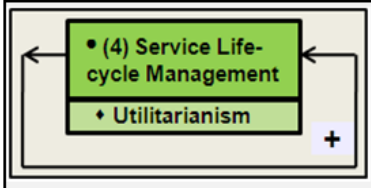
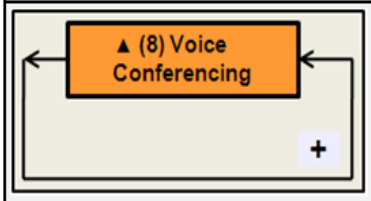
Table 5.9: Conceptual Policy Views polarised relationships analysis

Legend				
Perspective Type			Ethical Inclination	
● Organisational	▲ Technical	■ Personal and Sociological	♦ Organisational	♠ Personal and Sociological

Relationships Representation	Systemic Level Relationships Analysis	Research Context Implicating Conclusions
Level 1		
	Green level measurements', carried out on the basis of utilitarianism, will positively reinforce 'Software upgrades' toward increased happiness of environmental concerns; while 'Software upgrades' will positively increase 'Recycling' due to less hardware redundancy. In turn 'Recycling' will promote 'Green level measurements' positively as the business benefits of 'Recycling' will promote the execution of further 'Green level measurements' as means of control over the cycle. Since no negative relationships exist within this loop, it is impact amplifying and reinforcing of the conceptual policy views.	The 'Organisational' perspective of 'Green level measurements' is the dominant driving force within the cycle of inducing the 'Technical' perspectives of 'Software upgrades' and 'Recycling'. The researcher however finds an ethical inclination of universalism more appropriate to 'Green level measurements' being such a driving force. The future implication (Clary & Wagner, 1984: 263) of carrying out 'Green level measurements', as a strategic 'Organisational' perspective, is anticipated to further promote 'Software upgrades' and 'Recycling'; thus relating to the overall positive loop polarity finding.
Level 2		
	Since no negative relationships are present within this loop, the overall result is that of impact amplification. Correspondingly, both 'Environmental impact recognition' and 'Energy usage monitoring' regard action based on data analysis; both of which is anticipated to reinforce the feasibility of the action of the other.	It is interesting to note that both conceptual policy views are of the 'Organisational' perspective, being represented among the top directed grah levels; thus implicating that long-range organisational planning (Linstone & Meltsner, 1984: 362) is required for the majority of other conceptual policy views, while this is not typical of 'Organisational' perspectives. The researcher however agrees with the future implications of this loop, its relationships and level, as being strategically correct.
Level 3		
	A positive relationship exists regarding 'Assets optimisation' having the ability to be self-reinforcing in its actions, via its recursive relation (Roos & Hall, 1980: 59); resulting in an overall positive loop. 'Assets optimisation' relates well to level 3 in that it further induces positive 'Recycling' actions; due to it minimizing recycling products.	An 'Organisational' perspective again represents within the top levels of the directed graph, indicating a dominant business strategy being promoted toward feasibility of the overall conceptual policy views combination. An 'Aesthetic' perspective might have contrasted with this view of retaining aged assets, had it been relevant for analysis. The researcher includes consideration for the existence of alternate cost-saving agendas existing with the submission of this view; since the pertaining interviewee held a management position.

Level 4		
	A positive recurring relationship exists with regard to 'Corporate IT governance'. This assignment has been based on the interpretive concept that the execution of this policy will lead to the increased feasibility of it being repeated. It also functions as a key decision point within the directed graph structure, with many conceptual policy views being dependant on it; being in line with its importance as organisation-enabling 'Technical' perspective means.	This 'Technical' perspective is well-positioned within the research context directed graph, as it will serve as a plan (Linstone & Meltsner, 1984: 362) and prerequisite for the resultant data output views in level 2. 'Corporate IT governance' is a systemically desirable conceptual policy view, providing for the required plan for 'Organisational' perspectives to be executed via. The cultural feasibility of 'Corporate IT governance' within specific SMME types may however warrant further consideration.
Level 5		
	The 'Reduced paper trail' conceptual policy view has a definite reinforcing attitude toward that of 'Green IT office design'; while the last-mentioned will typically include and result in a positive inducing of the 'Reduced paper trail' action; resulting in an overall positive loop. It is interesting to find two conceptual policy views being typically perceived as having immense differences in scale of requirements toward implementation, on a same directed graph level. The scenario of 'Green IT office design' however having more dependant relationships than that of 'Reduced paper trail', however accommodates for their levels being the same.	Both conceptual policy views represent the first instances of the 'Personal and Sociological' perspective being represented within the directed graph, on a fifth level of implementation dependence. The researcher is in agreement with 'Green IT office design's ethical inclination of relativism; especially as unique situations of respective SMMEs may or may not deem this policy feasible. The feedback loop existing between 'Reduced paper trail' and 'Green IT office design' appropriately enables the implementation of either policy toward further implementing those of higher levels.
Level 6		
	A definite positive reinforcement relationship exists with regard to the existence of 'Green products', as per the researcher's world views. An overall positive feedback loop results. 'Green products' furthermore represents a decision point within the directed graph; deeming it an requirement before attempting the implementation of higher level conceptual policy views. In regarding such higher views, the level of 'Green products' is found to be appropriate.	The researcher is in agreement with 'Green products' ethical inclination of consequentialism, toward providing support for the implementation of this conceptual policy view. Consideration for 'Green products' in terms of hardware, and not only software, as per the interviewee, is however recommended. Furthermore, this view may be aligned with that of an 'Organisational' perspective in terms of strategy as well.

Level 7		
	An increase in 'Equipment categories' is found to have a positive increase in 'Green web development', due to the relationships existing between functions available to develop with via certain hardware products. In turn, 'Green web development' is related within the directed graph as sole decision-point to progress with policy implementation from level 5 upward; thus deeming it a prerequisite, and securing its existence toward in turn acquiring suitable 'Equipment categories'. An overall positive loop results.	Both the ethical inclinations of the conceptual policy views is found to be most appropriate, in that the efficiency of a policy relating to 'Equipment categories' use will depend on its SMME's scenario; while the benefits of 'Green web development' are so easily achievable that its positive consequences should function as the main decision drivers in implementing the policy. It is interesting that the 'Organisational' perspective of 'Equipment categories' have less dependant relationships, while the 'Personal and Sociological' perspective of 'Green web development' has more, in spite of this perspective not traditionally effecting changes in many variables (Linstone & Meltsner, 1984: 362).
Level 8		
	These conceptual policy views are suited to their relationships indicated. A decreased in the execution of a 'Qualitative desktops' policy, will appropriately lead to a decrease in the execution of 'Server room planning'; as the server room will have to compensate for loss in desktops policy. Also, a decrease in 'Server room planning' will deem 'Qualitative desktops' efforts less effective. An overall positive loop exists, due to an even number of negative relationships.	As the lower levels of the directed graph is reached, 'Technical' perspectives such as these appropriately increasingly represent. 'Qualitative desktops' depends on no other conceptual policy views to be implemented, most suitably; as this is anticipated to be an initial policy to be easily implemented in most South African SMME's. 'Server room planning' appropriately depends on other conceptual policy view inputs, as this is traditionally the origin of an effectively planned hardware policy, including that of 'Qualitative desktops'.
Level 9		
	The implementation of a 'Multifunction printing' conceptual view policy, will positively reinforce the execution of 'Baselined IT' measurements. 'Baselined IT' policies will in turn promote among others 'Multifunction printing'. An overall positive loop exists for this level of relationships, due to no negative relationships existing.	The 'Technical' perspective of 'Baselined IT' is found to related to the 'Organisational' perspective of 'Green IT measurements', with the distinction that the first refers to post-implementation data analyses, while the second promotes pre-implementation measurements setting. Relativism as ethical inclination suits to that of 'Baselined IT', as respective SMME's might necessitate varying forms of this policy being implemented.

Level 10		
	Service life-cycle management' represents within the second most lowest level of the directed graph, as a reinforcing loop with itself. A positive feasibility thus suits in relation to its high level of importance, toward implementing other conceptual policy views based on it.	This 'Organisational' perspective represents that of the most highest importance of all such perspectives, in having few dependencies and a high level of importance based on hierarchical level. The researcher is in support of the well-balanced representation of 'Organisational' perspectives at the top and bottom levels of the directed graph; toward a balanced business strategy, and proactively preventing critical knowledge gaps as such (Webster & Watson, 2002: xiii). This policy may be implemented to differing degrees within respective SMME's, but its principles should be adhered to.
Level 11		
	An overall positive loop exists with regard to 'Voice conferencing' as conceptual policy view, to reinforce itself. As this policy is dependant on no others, it is suited as an initial means toward environmentally friendly information technology practice.	Voice conferencing' is a low cost, high saving and easy to attain and implement technological means of initiating environmentally friendly information technology practice. It is thus suited at the lowest level of the directed graph, and correctly so had no other policy input dependencies. The researcher however will have preferred level 11 to be represented by that of 'Service life-cycle management' as well, as dominant and initial means (Roos & Hall, 1980: 61) of developing strategies such as 'Voice conferencing' before implementation.

4.4.1 Systemic context conclusions

Based on Directed Graphing theory as set out in section 3.1.4 of this chapter, it is now possible to carry out the polarised relationships outcome alternatives in terms of systemic stability as discussed in table 5.1, as well as the previous analyses of Conceptual Policy View relationships, the inferring of overall systemic implications. This regards consideration for the stability and suitability of this prototyped systemic

combination of Conceptual Policy Views, toward evaluating its feasibility in implementation as such. The following conclusions pertain:

- In synthesising the resultant polarities interpreted per Directed Graph level, it is recognised that each and all of the levels have resulted in an overall positive feedback loop polarity outcome type.
- Based on this overall positive outcome, the system represented by this Conceptual Policy Views combination can be deemed an unstable systemic grouping, according to Adelson *et al*. (1984: 323), based on Axelrod (1976: 73).
- As a result, the system represented by this Conceptual Policy Views combination is also considered to be determinant in its outcomes; as it is motivated by its definite positive orientation (Roberts & Brown, 1975: 579).
- This positive systemic orientation being relevant, it is furthermore identified to be and is typical of open systems, of human- or societal natures; thus implicating and also confirming the prototype Conceptual Policy Views combination as such (Adelson *et al*., 1984: 326).
- In addition, it can be further derived that the prototype Conceptual Policy Views combination provides for a grouping that indicates strong support or unanimity in arriving at a decision or policy; with policy as consideration being especially relevant to the research context (Adelson *et al*., 1984: 326).
- Finally, due to the unstable nature of this Conceptual Policy Views system, a systemic inclination toward evolution and the promotion of change may be derived; thus indicating further support for the specific combination of Conceptual Policy Views as drivers with the intent to bring about transformation within the information technology policies of the implementing organisations.

In concluding the data analysis of this research project, in order to appropriate the specific hierarchical and relationships set of Conceptual Policy Views for

implementation in South African SMMEs as prototyped conceptual framework; it is next necessary to relate the discussed systemic stability conclusions to those of the pertinent research context. It seems fitting to consider and present these research-context-implicating conclusions, in the next and final chapter.

5. Data summary

When this data analysis synthesis and interpretation is carried out, its activities can be summarised as consisting of the application of Directed Graphing theory, as pertaining to the Multiple Perspectives Approach and directed toward identifying and examining hierarchical levels and consequent relationships among the collected Conceptual Policy Views. The latter were previously referred to as mutually beneficial Key Sustainability Factor Enablers.

This process consisted of the execution of Hierarchical Directed Graphing in setting up a Reachability Matrix, based on the researcher's interpretive world view, as well as iteration matrices, resulting in a total of eleven systemic levels. Signed Directed Graphing was next carried out in terms of producing a block partitioned Reachability Matrix and presenting a resultant Directed Graph, in concluding and displaying further systemic relationships; as well as in terms of producing a polarised hierarchical and overall systemic analysis of the resultant set of Conceptual Policy Views.

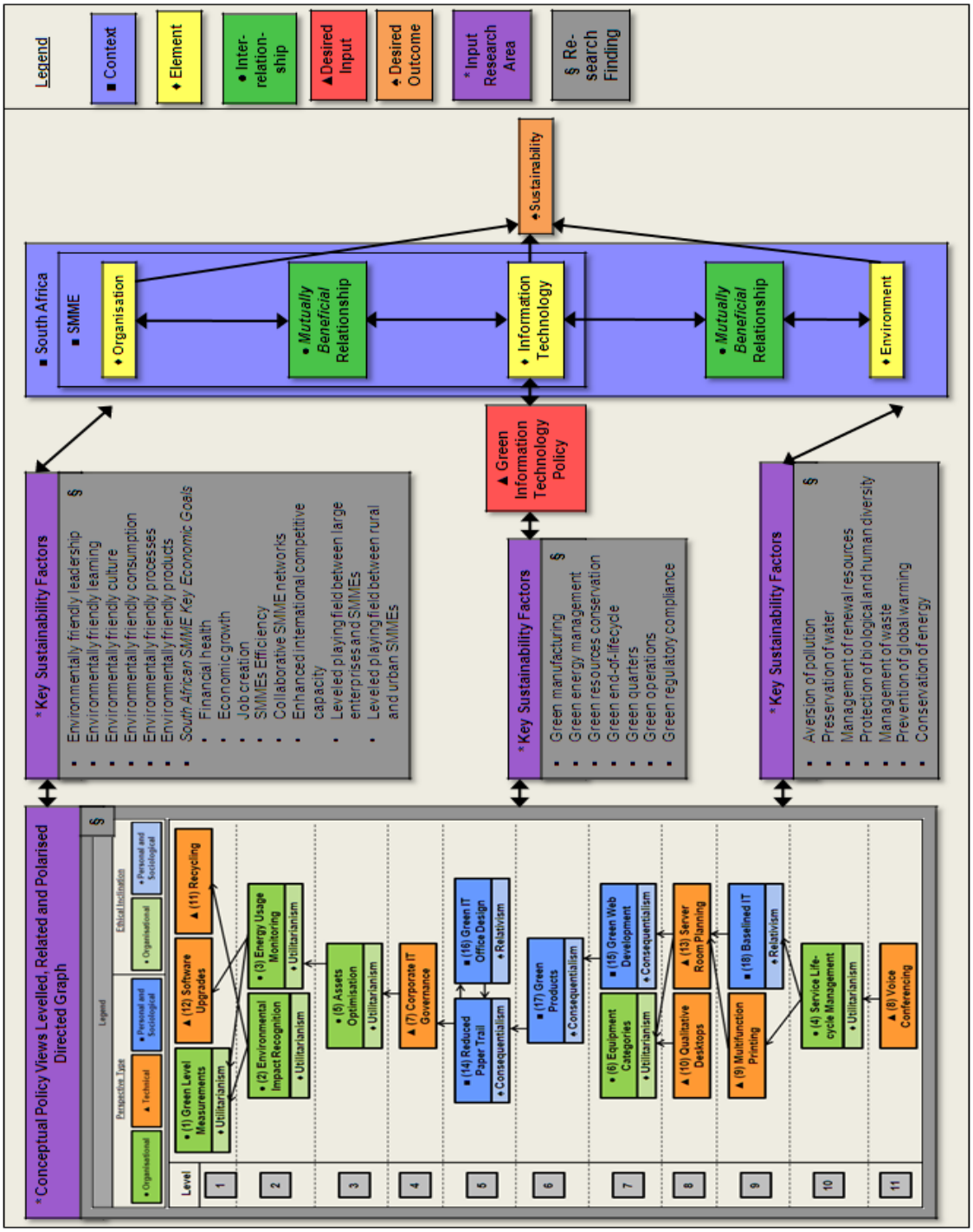
The purpose of this synthesis and interpretation exercise was to identify the stability and suitability of the set of Conceptual Policy Views, also based on their specific relations to each other; toward ascertaining its feasibility as a suggested prototype conceptual framework for implementation by South African SMMEs, to arrive at a

mutually beneficial environment-friendly information technology practice. The resulting overall systemic conclusions derived from the analyses process confirmed the appropriateness of the Conceptual Policy Views set combination; while the practical implications of these, as pertaining to the specific research context, will be discussed in chapter 6, in concluding the research study.

A final contextually compiled graphical view of the research study status, in relation to its goals, is next presented; within the original Research Focus Areas figure, discussed in chapter 1 section 5.1. Accordingly, this chapter's outcome, namely levelled, related and polarised Conceptual Policy Views, toward an overall systemic stability status, are contextually presented in the form of a Directed Graph.

Finally, it must be noted that regard for the 'Ethical' perspective was continued throughout this chapter; in considering its data implications, within the resulting and via the conclusions derived from, the mentioned Directed Graph. Figure 5.2 consequently provides a graphical summing-up of the overall and completed data analysis, synthesis and interpretation.

Figure 5.2: Contextual Conceptual Policy Views Directed Graph consolidation



Towards a mutually sustainable environmentally friendly information technology policy framework for South African small, medium and micro enterprises.

6. Conclusion

The purpose of this fifth chapter was to qualitatively integrate and analyse the collected research data, namely, Key Sustainability Factor Enablers, now referred to as Conceptual Policy Views; to be consequently applied toward the construction of a correlated and interpreted prototype conceptual framework, as might have been achieved by typical green information technology policy developers, in selecting and prioritising such pertinent views for organisational implementations. This was primarily accomplished by discussing the theory of the pertinent data analysis method, Directed Graphing, as applicable to that of the Multiple Perspectives Approach, and by identifying and examining hierarchical levels and consequent relationships among Conceptual Policy views, via a Hierarchical Reachability Matrix, iteration matrices and Block Partitioned Reachability Matrix; This resulted in the identification of eleven levels and thus suggested an order to and dependencies between Conceptual Policy Views for subsequent implementations. A consequently produced Directed Graph and Hierarchical Polarisations exercise served as inputs to a levelled and overall systemic analysis of the specific set of Conceptual Policy views and relations combination; resulting in an overall positive polarity outcome. An answer to the third and final secondary research question namely, *"How do the mutually beneficial key sustainability factor enablers, required in South Africa to respectively sustain a typical SMME organisation, the environment and information technology, correlate with each other?",* was provided; in having discussed the significances of the relations and polarities among the levels of Conceptual Policy Views, and also having concluded this interpretation and Directed Graphing combination as being feasible to implement as prototyped environment-friendly information technology policies conceptual framework, in endeavouring mutually beneficial and environment-friendly information technology practice within South African SMMEs.

In the following final chapter this study builds on the now having been related and substantiated as being feasible for implementation, Conceptual Policy Views set; in practically relating it's identified systemic conclusions to those of the research context. A prototype conceptual framework, to be implemented in endeavouring mutually beneficial sustainability in terms of environment-friendly information technology practice within South African SMMEs, is consequently introduced, to provide an answer to the main research question, before concluding the study.

CHAPTER 6

CONCLUSION AND RESEARCH REVIEW: TOWARD CONCEPTUAL FRAMEWORK IMPLEMENTATION

1. Introduction

The purpose of this chapter is to bring this research endeavour to a close by means of introducing the study's central output in the form of a prototype conceptual framework, next discussing its applications and finally evaluating the study as a whole. An answer to the main research question, *"What set of factors should South African SMME organisations seek to implement when instituting an environment-friendly information technology policy that consists of mutually beneficial sustainability relations between the organisation, the environment and information technology?",* is produced in relating the systemic outcomes of the related set of Conceptual Policy Views, having resulted from chapter 4 section 4.4.1, to that of the research context. In addition, implementation strategies and implications of using the conceptual framework are discussed; before concluding the chapter, by reviewing the research findings and the project as a whole according to the criteria study limitations, knowledge gaps, knowledge contributions, future research, study challenges, a researcher self-evaluation and a research findings summary.

2. Research context conclusions

In chapter 5 section 4.4.1 it was established that the pertinent and related set of Conceptual Policy Views is feasible toward desired systemic outcomes, as a basis for

the development of a conceptual framework. In progressing toward the institution of this intended conceptual framework, it is next necessary to reflect on the implications of these systemic feasibility outcomes; in terms of their pertinence to the research context, in concluding their significance for information technology managers as intended users of the conceptual framework. The following overall conclusions can be drawn with regard to the suitability of the produced Conceptual Policy Views set, as relating to the research context:

- The outcome of an overall positive system polarity (Adelson *et al.,* 1984: 325) implicates and qualifies the complete set and combination of suggested information technology policies, as practical to implement as a mutually beneficial environmentally friendly information technology strategy within South African SMMEs. This outcome is considered to be sound since no suggested policies counteract each other, due to a united singular research purpose of promoting the topic of mutually beneficial sustainability; thus not having provided for policy suggestions in opposition to the project. This research outcome provides an answer to the main research question; to be considered below.
- The outcome of an unstable systemic grouping (Roberts & Brown, 1975: 579) implicates unison of the suggested information technology policies, toward producing change and evolution via its implementation and execution, as mutually beneficial environment-friendly information technology strategy. It provides verification for support and strength of the specifically combined set of information technology policies. This finding points to the interviewees having been like-minded; while the small number of respondents involved within this study also promoted this unity of views.
- The outcome of a determinant systemic status refers to that of a definite systemic orientation; as is the case in the overall positive polarity finding (Roberts & Brown, 1975: 579). This implies that the specific set of recommended policies,

together with the specific manner in which they were related to each other for the purposes of an implementation order of events, is in strong support for it as strategy; which is typical for the formulation of feasible policies.

- The outcome of the framework system as an open system type, typical of human- or societal natures (Adelson *et al*., 1984: 326); implies that the specific set and combination of policies, will function in an environment within which it will interact and be influenced by factors not only pertaining to the set of information technology policies itself, when implemented; for example, by politics and human emotions. This is correct in regarding the policies as functioning from within organisations, as open systems. It furthermore implies the restlessness typical of such systems; thus indicating an orientation towards positively promoting changes as a result of the environmental interaction and as prompted by the information technology policies combination.
- The final outcome of strong support or unanimity toward the conclusion of a decision or policy (Adelson *et al*., 1984: 326) implies that the specific set of information technology policy suggestions has reached a decision on its consequent feasible implementation. The set of policies as a whole is in this instance regarded as a single policy, for which a decision had to be reached whether to utilise or dismiss it. This outcome is thus favourable in confirming the suitability of the set of policies for implementation.

3. Prototype conceptual framework

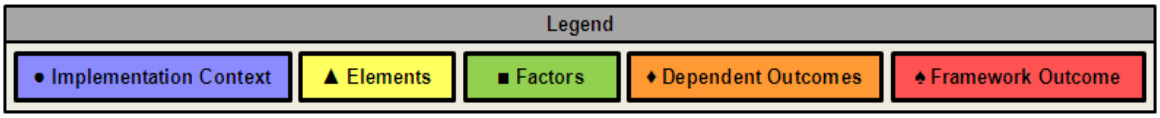
Schwarz *et al.* (2007: 41) define a framework as an exposition of a set of assumptions, concepts, values, and practices in order to understand research within a body of knowledge. A framework of the conceptual type, in turn, is described as a set of over-arching ideas and principles from relevant fields of study, used to

compose a consequent representation of it, in indicating meaning from findings, toward developing awareness and understanding of a situation being studied, according to Reichel & Ramey (1987) within Smyth (2004: 167-168). The framework developed in the present research project was intended to be and consequently produced that of the conceptual type.

Schwarz *et al.* (2007: 33) advocate a number of possible purposes for frameworks. In the present case it was found that two of these purposes apply. The first, namely to summarize the assumptions of a research stream, correlates with this study in that the disparate domains of environmentalism, organizational theory, information technology and sustainability, have been studied in unified form towards producing an conceptual framework of mutual benefit to all elements. The second, namely to provide new focus within a research stream, correlates with this study in that it draws attention to an area of mutually beneficial sustainability among the research elements in which they do not yet seem to have been studied in unison for this purpose.

The conceptual framework produced as outcome of this research study is now introduced, in order to answer the main research question, *"What set of factors should South African SMME organisations seek to implement when instituting an environment-friendly information technology policy that consists of mutually beneficial sustainability relations between the organisation, the environment and information technology?"*; based on the outcomes of the four secondary research questions as per chapters 2 to 5 of this document. The subsequent goal of this conceptual framework is that of providing a sampled set of interconnected information technology factors, represented in an implementation order which has been evaluated toward being feasible, and highlighting the sustainability implications of each factor. The conceptual framework accordingly serves as a prototype that may

be implemented toward achieving specific sustainability outcomes relating to each of the study elements, 'Environment', South African SMME 'Organisations' and 'Information Technologies'; for the mutual benefit of them all. Figure 6.1 presents this conceptual framework.



The conceptual framework is described as being constituted of the following:

- Implementation context: Residing within the boundaries of South Africa and its SMMEs; as per chapter 1 section 4.
- Elements: The 'Environment', 'Organisations' and 'Information Technologies', represent elements that may be applied toward mutual benefit; as per chapter 1 section 4.1.
- Factors: 'Information Technology' policies related and represented in a prototyped verified order of implementation feasibility; as per chapter 5 sections 4.3 to 5.
- Dependent outcomes: Key Sustainability Factors of respective elements, beneficially resulting in individual element sustainability levels, due to specific 'Information Technology' policies being implemented. As per chapter 3 section 4.1 and chapter 4 section 3.2.
- Framework outcome: Mutually beneficial sustainability for all elements, as a result of the prototyped conceptual framework's complete and ordered implementation. As per the findings of all previously listed constituents as well as that of chapter 5 section 4.4.

4. Conceptual framework implementation

In further clarifying the knowledge accumulated (Webster & Watson, 2002: xvii) toward use via the proposed conceptual framework, here follow recommendations for consideration in implementing it:

- Based on the suggested conceptual framework's high level of policy inter-dependencies, a phased, but complete, implementation is recommended. Consequently, the policies as listed within the conceptual framework will require to be implemented from the top down, for each of the eleven pertinent levels; with those policies serving as input to the greatest amount of subsequent others, receiving priority within respective levels.
- A number of aspects may inhibit South African SMMEs in implementing the prototyped conceptual framework in full or in the suggested manner; due to practical and feasibility-related situations, such as for example SMMEs' change readiness levels and access to resources. Accordingly, logical implementation alternatives are suggested. These implementation variations are based on the prerequisite that the recommended original implementation order of events and pertinent policy interdependencies in doing so, are still adhered to; for selections of specific policies which it may be opted to realize. As such, the integrity of the conceptual framework as a whole is not compromised. These suggested implementation alternatives are as follows:
  - The least dependent and most strongly driving policies may be implemented first in gaining quick initial benefits. The least dependent policy is that represented within the first conceptual framework level, namely 'Voice Conferencing', thus not being dependent on any other policies and being most easily realised; while still ensuring a correct start to the implementation phases. The most strongly driving policy, namely 'Green IT Office Design', will in turn prompt and enable the implementation of the greatest amount of other conceptual framework policies; thus allowing for further concurrent and rapid implementation approaches.
  - Policies can be selectively implemented, in considering each policy in terms of the impact that its realisation might have for respective organisational

situations, for example, regarding finances and policy implementation outcomes.

- Each policy can be traced to its pertaining organisational Key Sustainability Factors, represented as Dependant Outcomes within the conceptual framework, per policy. Accordingly, South African SMMEs can identify their key goals among the mentioned factors, and implement corresponding information technology policies.
- According to the feasibility of implementing specific types of conceptual framework information technology policies, the users of the conceptual framework can group the policies according to what actions they will require on behalf of the organization, for example, changes to existing policies, discontinuations of existing policies and additions of new policies. Individual organizations might be more capable, in terms of, for example, funding and time, or to implement certain of such types more easily than others.

- It is recommended that the implementation of the proposed conceptual framework be regarded in conjunction with all other formal corporate plans and strategies, in setting realistic expectations and goals with regard to the requirements and implications of such an undertaking.
- The social context within which information technologies are applied and which the environment supports is critical and an influence in planning and implementation activities regarding sustainability solutions. The status of human relationships, in proactively preventing resistance to new information technology policies, and economic changes, in remaining realistic about implementation goals; should be monitored throughout the strategy life-cycle.

5. Anticipated implications

It can be predicted (Webster & Watson, 2002: xiii) that the findings of this study and resultant prototype conceptual framework, may either be utilised as is, or be interpreted and applied toward a different order of implementation, by its users, subject to the following considerations:

- Additional Conceptual Policy View combinations may be prototyped in testing strategies, via varying users, as pertaining to specific SMME scenarios; by experimenting with changes in the Directed Graph (Adelson *et al*., 1984: 326). Examples of such changes include turning selected causal relationships on and off (Roos & Hall, 1980: 60) and altering the polarities of relationships; toward modifying the system's overall energy use (Roberts & Brown, 1975: 578).
- An organisation's inclination toward the implementation or non-implementation of the suggested conceptual policy framework may be determined by the level of ease and duration of implementation pertaining to respective policies; in addition to the feasibility aspects determined in this study.
- The differing roles and orientations of ethics within an organisation will influence the measures according to which the conceptual framework is considered, accordingly implemented and strategically thought about. It is thus important that the dominant strategy (Roos & Hall, 1980: 62) in terms of ethics be identified in advance of such decision-making.
- The governing perspectives of the resultant users of the conceptual framework are anticipated to lead considerations regarding its policies, in terms of what is thought to be most and least important toward implementation. It is anticipated that, since the conceptual framework is intended for use within information technology departments, technical perspectives and corresponding policies will lead the way.

6. Study limitations

Within chapter 1 section 8, the limitations of this study have been set out: contextually, South Africa; organisationally, small-to-medium-and-micro enterprises and all industry types; and as subject, information technologies, irrespective of whether are being hosted, sold, produced or utilised by these organisations. Study boundaries thus specifically excluded issues regarding enforcement, transitioning and legalities concerning the proposed conceptual framework; with the pertaining period being the current via literature from any timeframe.

In carrying out this research, the following further limitations to the study were also recognised:

- A scarcity of sources of information regarding the specific topic in context has been confirmed throughout. As a result, the interpretive nature of this study was extensively employed toward deriving outcomes of value.
- The Multiple Perspective views' data, collected via the conducted interviews, have, in the opinion of the researcher, limited the study in terms of possible outcomes. Although the views submitted were interesting and resulted as feasible for implementation, the researcher would have wanted to gain input of higher value in terms of exclusivity of information, as well as its criticality and levels of detail and importance. It must be considered that the information provided to the interviewees in preparation for their interviews, might have guided their inputs too strongly, thus possibly directing and limiting the spectrum of policy views submitted. In addition, the researcher is of the opinion that too few interviews were conducted, toward accumulating data toward a greater level of saturation; before conducting the in-depth data analysis activities carried out.

- Research outcomes are often verified in terms of theoretical examinations or investigation by topic experts. It is however a limitation of this study that it cannot be measured for correctness as such, due to the varied outcomes it might have and the consequent prototype nature of the conceptual framework produced. It is, in turn, a counter benefit, that the Directed Graphing Method in itself serves as a means of not only analysing but also verifying the feasibility of the data collected and combined; by having the resultant systemic stability outcome implicate feasibility and appropriateness, as per chapter 5 sections 2 and 4.4.1; thus providing substantiation of the resultant conceptual framework. In next regarding a most appropriate means of validating study outcomes, it appears that verification in the form of consensus on the outcome of the resulting conceptual framework, by the interviewed experts, in addition to having executed the Directed Graphing method, would have increased the credibility of the study outcomes to a greater extent. Like-mindedness among interviewees mutually, and between the interviewees and the researcher, was however indicated via the data analysis process; thus similarly promoting the manner in which this research was validated, by only employing the Directed Graphing method.

7. Knowledge gaps

Knowledge gaps can be defined as patterns in the literature (Webster & Watson, 2002: xvii) or possible solutions that were not included in the research study under investigation, but that might warrant consideration in terms of the research context. The following pertaining knowledge gaps were identified:

- A pattern that exists within literature regarding the research topic is that of the human factor warranting extensive thought, in addressing sustainability questions via technology. Considerations that might have been included within this study,

concern a lack of human resources and of skill to utilise technologies (Davison *et al.*, 2000: 1); the strong need of humans to construct relationships with the world in environmental terms (Jennings & Zandbergen, 1995: 1026); the development of human resources management systems toward ecological sustainability (Starik & Rands, 1995: 920); the influence of information systems on institutional properties which stimulate eco-friendly behaviour (Chen *et al*., 2008: 188); and the idea that information ecology should focus on human aspects instead of technological processes (Mulvihill & Milan, 2007: 664).

- The costs involved, in terms of finances as well as opportunity via delay to implement and human resources input, regarding the implementation of the prototyped conceptual framework; have not been addressed in determining feasibility, as the focus of this study pertained to the specific data set. These aspects might however have been included within the context as well, had they been sought after.
- An interesting addition to this research might have included an analysis of the likelihood for the proposed information technology policies to be adopted by policy makers; as respective user types may enable, oppose or leverage it (Meltsner, 1984: 381). The typical characteristics of each of the Multiple Perspectives Approach types, in terms of role-players, as set out within chapter 4 section 2.2.2, may especially apply; as it is anticipated that each type will promote the policy views as represented by its perspective.
- Existing guidelines as well as current practices being successfully executed elsewhere, with regard to the research topic, might have also been included in this study for consideration; for example, the principles of ISO 14000 and those functioning within the United Kingdom.

8. Knowledge contributions

In chapter 1 section 9, an anticipated list of contributions to the field of information systems was offered, following from this research study. It is next described how these and additional outcomes have been met, based on the results anticipated in utilising the theory of or practically implementing the conceptual framework prototyped:

- The existing theoretical body of knowledge in the subject area has been extended, in that new terminologies have been suggested, together with ways in which innovation may be achieved (Roos & Hall, 1980: 66); due to and based on the unstable and evolutionary status of the resultant conceptual framework's system type and inter-dependencies, as per its Directed Graph format. This new and basic information may be applied toward serving the interests of business management practitioners, which might accordingly impose policies resulting from the study; of academics in the fields of ecology and information systems, who may find the research outcomes as contributing to academic endeavours; of the information technology industry and its human resources, who may apply the suggested conceptual framework in increasingly sustaining their products and services; and of the environment, which may be impacted on in less harmful ways toward ensuring safe natural resources for future generations.
- The resultant conceptual framework is anticipated to increase understanding of specifically the relationships that exist between information technology and ecological sustainability (Chen *et al*., 2008: 193), thus possibly impacting on and altering future decision-making criteria; as more insight is gained, mental models are updated, consequent learning takes place and tacit knowledge is revised (Courtney, 2001: 31) by framework users. New ways of thought and opportunities thus become possible, via revised practices. Consequent change

in conducting professions, based on decisions, incorporating regard for the outputs of this research and being made by SMME green information technology policy developers; is possible, in instances where suggested conceptual framework policies are adopted.

- An increase in awareness, specifically suitable to the South African and SMMEs context, is anticipated; in terms of the offered alternatives, made available for consideration by such organisations toward promoting their sustainability levels. Readers and users of this research document might as such access, offer and provide references to the knowledge provided by it, to further parties who might benefit from it. The study outcomes may accordingly be considered of value for use by the South African government and environmental- or information-technology regulating bodies; to consider in relation to their respectively existing policies, in positively initiating and progressing toward implementing mutually beneficial environmentally friendly practices in South Africa, via such awareness campaigns. This study further contributes to knowledge in the field of information systems, by having combined seemingly disparate lines of environmental, organisational, information-technological and sociological knowledge bases; for primary use of the conceptual framework outcome, by the information technology industry; thus building on previous industry findings (Webster & Watson, 2002: xix).

9. Future research

The researcher has identified and uncovered a number of future research topics, as appropriately resulting from this research endeavour, as well as from the literature, as follows:

- Interesting research results may be obtained in re-conducting this same study, not only with new interviewee candidates. This might provide insight into suggested changes of the recommended policy views by the original interviewees; while new policy views can be acquired via the latest interviewees set; as factors toward continuously updating the prototype conceptual framework.
- As an alternative Directed Graphing method, Weighted Directed Graphing is suggested as a possible future research area. Accordingly, the most and least important and possibly omitted perspectives, as well as an overall systemic strength as explicit value, may be discovered; from a typical user's point of view. This is achieved via ranking, thus indicating the strength of relationships between views, while taking time lag into consideration (Roberts & Brown, 1975: 579-580). This approach might provide a solution to the limited views study limitation discussed in section 6 of this chapter, in that it provides for the addition of views for analysis, by its reviewers as well as researcher. This approach may also provide insight into how green policy developers will approach and analyse policy views toward implementation within their respective organisations. Representatives from the South African Department of Environmental Affairs as well as the South African State Information Technology Agency are recommended for participation, in such a scenario.
- The theory of triple bottom line thinking, advocating consideration for all of the entities namely people, planet and profit, toward environmental, social and economic sustainability (Elkington, 1998: 8), is suggested for future research, in terms of combining its theories with that of the conceptual framework research results acquired, by means of a further literature review. The anticipated outcome will be that of a further encompassing complementary view of both the data collected and verified as feasible for implementation via this study, as well as that of the concepts promoted via this revolutionary theory. This will also

accommodate Chen *et al*.'s (2008: 193) suggestion of studying societal levels of information systems in terms of their relationships to ecological maintenance; in response to this research endeavour having only focused on the organisational level.

- The investigation toward and development of detailed instructional manuals, on implementing the mutually beneficial information technology and organisational sustainability policies and levels, as pertaining to each one proposed within the provided conceptual framework, is recommended to be set up by scholars such as the present author; in guiding users toward the successful achievement of the framework. Further research pertaining to the expansion of knowledge development and user documentation, is suggested to regard that of environmental management- (Boiral, 2007: 139) and human resource systems, as well as programme outlines for educational courses on environmental awareness within businesses (Pollack, 2008); based on the conceptual framework.
- Research providing outcomes that enable the assessment of South African SMMEs in terms of change readiness and extents, in relation to the degree of change anticipated by the implementation of the prototyped conceptual framework; will provide valuable insights in terms of phased implementation approaches planning and feasibility (Meltsner, 1984: 381) of policies being implemented at specific periods in time.

10. Study challenges

In carrying out this research study, a number of challenges presented itself; as may be expected with exploratory endeavours toward creating new knowledge. The researcher has opted to regard the occurrence of such scenarios as learning

experience; in preventing similar reoccurrences throughout consequent sections of this study as well as future research undertakings. The four key challenges pertinent to this research study were:

- To have combined and made valid deductions from literature on the subject matter, as none relating to the research context as a whole, including consideration for all of the pertinent elements namely, 'Environment', 'Organisations', South African SMMEs and 'Information Technology', as mutually benefiting sustainability parties, was available at the time of this research.
- To have arranged for time out of the bursting schedules of expert industry representatives, to interview. Interviews had to be arranged following a number of official channels and approvals, while detail level preparation for the interviews as well as the interviewees themselves in preparation, where necessary. Full flexibility in terms of dates, times, locations and communication means where required on behalf of the researcher.
- To have simplified the complex mathematical descriptions of the theory of the Directed Graphing approach, toward introducing and applying the method in a manner suitable to that of the information systems domain. The researcher had to conduct extensive reading and carry out multiple practical exercises toward ensuring an accurate comprehension and performing of the method is produced.
- To have qualitatively selected and limited the extent of this document in terms of word count; while still ensuring sufficient descriptive and explanatory detail on the subject matter, methods and findings.

11. Researcher self-evaluation

In conducting this research study, the researcher did not only acquire knowledge of the subject matter and research methods pertaining; but also of the carrying out of

research in itself. Accordingly, a self-evaluation is provided, in terms of lessons learned and changes suggested by the researcher, to that of this research endeavour, in retrospect; toward having gained the highest effectiveness of study:

- The researcher recommends a more rigid scope to be set in terms of the focuses of views that are permitted for recommendation via Multiple Perspectives Approach interviews, in carrying out possible consequent similar research studies; for example, specifically regarding only strategy or products. This might provide a more coherent set of views to further relate. This is suggested to be done for respective domains of the subject matter, in attaining specialised inputs. The goal, however, with this research study, was to attain information free from focus constraints; toward having rather evaluated and permitted the views for use based on their levels of perceived criticality to the research context as a whole. However, in considering the effects of having in turn employed a more grounded and less focused scope regarding policy views permitted for submission, the researcher also acknowledges that a collection of views representing interviewees' opinions and world views to a greater extent, could have been accomplished. Accordingly, the researcher concludes that electing either one of these two approaches, could have held more benefit for the quality of data collected; due to the greater level of specialisation involved in either rigidly delineating or permitting freedom of opinions of perspectives, achieved.
- In considering the specific policy views acquired via the Multiple Perspectives Approach interviewing cycle, the researcher suggests to have rather interviewed more experts or to have required a greater number of views for submission by the current set of experts, per perspective; toward having gained more and more encompassing views. The researcher would have wanted to receive a larger quantity, greater variation and higher quality of views; to use as collected data within further analyses exercises. In addition, the researcher is of the opinion

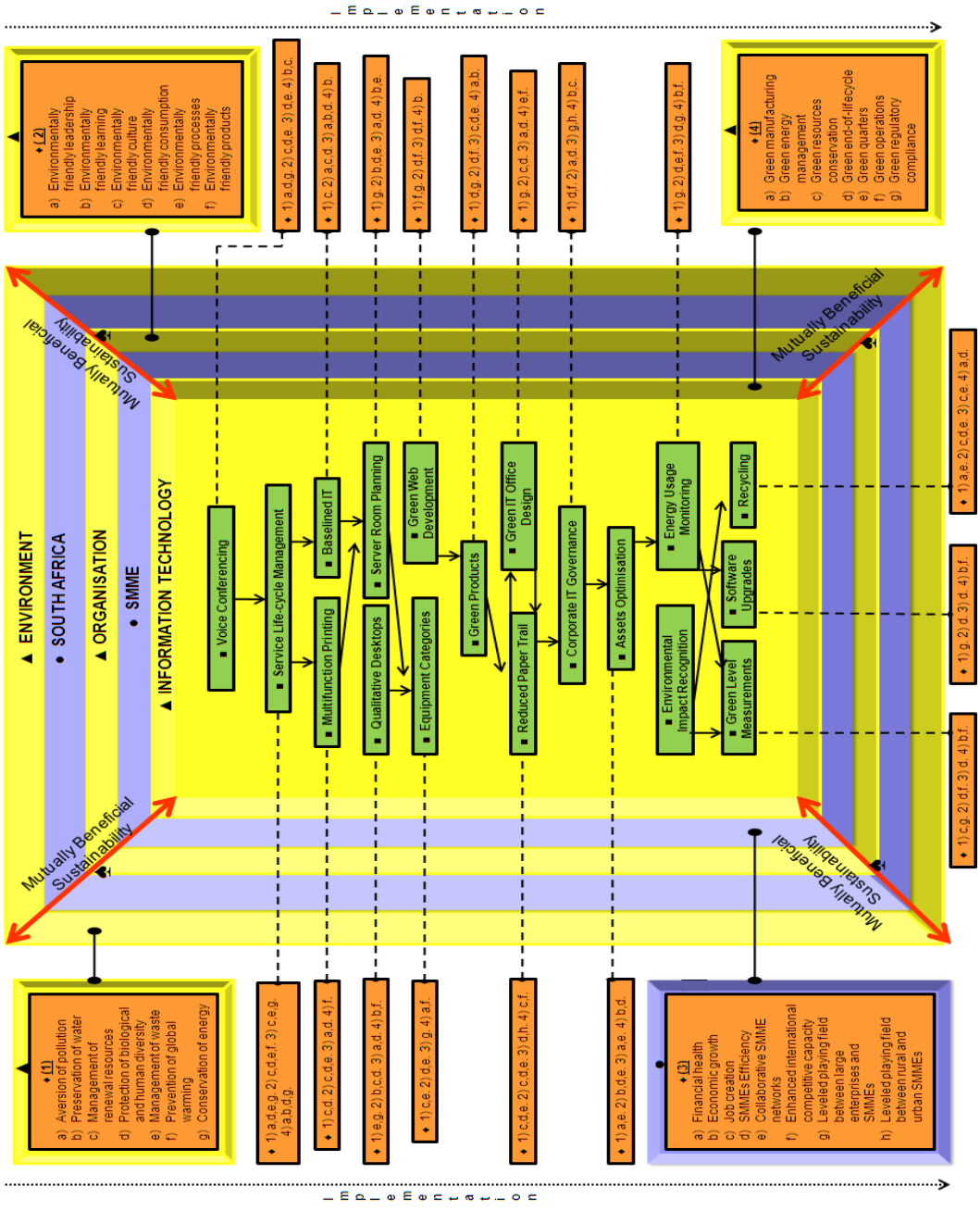
that if interviewees functioning within SMMEs are involved within such more extensive data collection activities, a greater level of data saturation as well as better balanced set of expert and experience motivated policy views, may be achieved, than was produced via this expert-views-based study. With a high-level conceptual framework, however, now being made available via this study, and having learned from the current study's outputs; the researcher would thus enjoy carrying out a similar study on a larger scale, involving, for example, five green information technology consulting expert representatives and five green information technology practitioners from within SMMEs; with the goal of attaining more, more detailed and more varied views. This may for example involve the recommendation of specific standards, product, brands and technological settings. It should be noted that the researcher remains in support of and will opt to apply the same customised strategy of selecting interviewees and gathering data, under such circumstances; thus remaining in line with the theory of the Multiple Perspectives Approach, as described in chapter 4 section 2.2.

- The researcher is of the opinion that the theoretically diligence with which this research study was executed, was of more value to the researcher in terms of knowledge attained; than it was in terms of the knowledge outputs created on the subject matter for possible use by green information technology policy developers. In coming to this conclusion the researcher has learned that a fine balance needs to be striven for in achieving both outcomes, in that especially the quality of study knowledge outputs should not be determined solely by parties external to a research endeavour; as was the case with this study, via the inputs acquired by means of interviews, having resulted in the data set used toward the conceptual framework's formulation.
- Regarding activities found to be qualitatively carried out within this study, the researcher reports being at ease with the levels of eminence, stance, knowledge

and experience of the study interview participants; as the involvement of interviewees displaying the attributes of those that have participated within this study is not taken for granted by the researcher. A number of protocols and study delays had to be accommodated by the researcher, toward having secured these specifically selected interview participants.

- Pertaining administrative aspects of having conducted this research study, the researcher has learned that it is important to aim to complete substantive portions of research and data analysis activities, toward and before setting out to ideally document complete sections or chapters of a thesis document. The researcher acknowledges that an interpretive hermeneutical learning process such as this, typically involves revisiting previous research sections. In however regarding the extent to which such recurring visits occurred throughout this research endeavour, as being at an average of four revisits per topic area; the researcher will prefer to aim to reduce the number of such occurrences via the before-mentioned measures, toward recording higher qualities and more inclusive versions of information during respective documentations.
- Although the researcher employed Directed Graphing theory toward conducting what is perceived as a thorough data analysis exercise within this study, the researcher acknowledges that a more appropriate alternative to this might have included a less detailed version of data analysis, but instead including a research section with the purpose of having the data analyses verified by suitable parties external to the study, for example by the initially interviewed or a new group of green information technology experts. The researcher as such recommends a group-wise, rather than researcher exclusively, comparison of conceptual policy views, toward having concluded on the Reachability Matrix provided within point 4.1 of chapter 5.

Figure 6.1: Conceptual framework: Toward environment-friendly information technology in South African SMME organisations in engendering mutually beneficial sustainability



Towards a mutually sustainable environmentally friendly information technology policy framework for South African small, medium and micro enterprises.

12. Research findings summary

The outcomes of this research study, set out in summary per chapter provide an overview of the endeavour outputs achieved as a whole:

- Chapter 1: The 'Environment', 'Organisations', South African SMMEs and 'Information Technology' were introduced and identified as relating elements that may be regarded as a whole, based on their mutual implications; to be studied toward the enablement of mutually beneficial sustainability among themselves. Research concepts, anticipated contributions, study limitations and resultant main and secondary questions, were set accordingly.
- Chapter 2: Interpretivism, with specific pertinence to qualitative induction as paradigm, and the Multiple Perspectives Approach, with specific use of document analyses, interviewing and the Directed Graphing methods, were identified as suitable in collecting and analysing data toward producing a suggested conceptual framework, constituted of policies to implement in endeavouring mutually beneficial sustainability among the elements introduced within chapter 1.
- Chapter 3: The main considerations that sustain each of the elements as introduced within chapter 1, were identified, analysed and termed Key Sustainability Factors, following a literature survey; toward serving as verification on whether the policies intended to recommend for implementation toward mutually beneficial sustainability, are indeed mutually sustainable, in complying with these considerations.
- Chapter 4: A total of eighteen recommendations, suggested to be implemented as policies toward the achievement of environment-friendly information technology practice within South African SMMEs, were acquired and termed Key Sustainability Factor Enablers, via interviews with green information technology

industry experts. Each interview participant represented a Multiple Perspectives Approach perspective type, namely 'Technical', 'Organisational' or 'Personal', and submitted a number of views per perspective; in applying a reversed but correct approach to the Multiple Perspectives Approach, as was appropriate toward producing qualitative study results. Each submitted recommendation had to comply with a minimum of one Key Sustainability Factor per element, to be approved toward inclusion as valid policy suggestion.

- Chapter 5: The Key Sustainability Factor Enablers, now termed Conceptual Policy Views, were interpreted and synthesised in relation to each other, in terms of hierarchy and dependencies, via the production of a Directed Graph; in order to determine the feasibility of implementing the specific set and combination of policy views as prototype conceptual framework. The resulting system's analysis has resulted in it being appropriate for implementation, via its eleven resulting levels of an overall positive systemic status; in being consequently classified as determinant, societal, open and unstable.
- Chapter 6: The prototyped combination of Conceptual Policy Views, was depicted in the form of a conceptual framework; based on which conclusions were discussed, in interpretively relating the systemic conclusions reached in chapter 5 to that of the research focus. The conceptual framework was consequently found to be in strong support of facilitating change; toward mutually beneficial environmental, organisational and information technological sustainability within South African SMMEs, via its set of specific policies. Finally, complementary conclusions with regard to the study as a whole were provided, in the form of further recommendations for conceptual framework implementation, anticipated implications, knowledge contributions and gaps, and future research recommendations.

13. Conclusion

The purpose of this sixth and final chapter, was to conclude this research endeavour by first of all introducing a prototype conceptual framework; to be implemented in endeavouring mutually beneficial sustainability in terms of environment-friendly information technology practices, within South African SMMEs. This has been achieved based on the findings of all the preceding chapters, in specifically relating the identified systemic conclusions of the Conceptual Policy Views set, to that of the research context; thus once more confirming the feasibility of use of this specific combination of information technology policies for implementation. The resultant conceptual framework provides for an ordered and related means of implementing its constituting information technology policies, while relating these policies to their respective mutually beneficial sustainability effects per element; thus enabling according strategic planning by green information technology users or decision-makers toward its incorporation in organisational policies and consequent implementations. An answer to the main research question of this study, *"What set of factors should South African SMME organisations seek to implement when instituting an environment-friendly information technology policy that consists of mutually beneficial sustainability relations between the organisation, the environment and information technology?",* was consequently produced. Next, in addition to having described the conceptual framework, seven implementation strategies and four anticipated implications of its use were also set out; before reviewing the research outcome and endeavour as a whole, and accordingly presenting three study limitations, four knowledge gaps, three knowledge contributions, five future research options, four study challenges, five researcher self-evaluation points and a research findings summary.

In referring to this research document's opening statement, namely that of Nelson Mandela stating at the Telecom 95 conference that the information revolution should be applied toward global economic prosperity (Davison *et al.*, 2000: 6) by using information technology to accelerate development and economic growth (Davison *et al.*, 2000: 2), it should be reaffirmed that this study has set out to contribute to the body of knowledge about means of applying information technologies toward creating desirable economic results and development. In furthering these causes, this study has aimed to place its main focus on the concept of sustainability, as being accomplishable via information technology, not only for economic benefit, but also for that of the environment; and was carried out with specific reference to the South African SMMEs market, as domain within which development opportunities vastly represent. As key outcome of this research study, a conceptual framework, constituted of information technology policies, analysed toward substantiating it's feasibility for implementation as well as mutual benefit in terms of sustainability for the environment, South African SMME organisations and information technology in itself, has consequently been produced; and is anticipated to be utilised by green information technology policy developers within South African SMMEs, in endeavouring mutually beneficial sustainability goals, similar to that of this study. Davison *et al.* (2000: 4) points out that policy-makers will have to embark on implementing sometimes challenging endeavours, toward reaping subsequent development and sustainability benefits, offered by information technology revolutions. The researcher would like to aspire for the conceptual framework produced via this study, to serve as a small offering toward simplifying and promoting the implementation of information technology-driven sustainability policies; as a feasible alternative to employ toward practically developing and maintaining not only South African SMME organisations and the environment, but also that of information technology as a domain.

GLOSSARY

CIO - Chief Information Officer

ICT - Information and Communication Technology

IT - Information Technology

MPA - Multiple Perspectives Approach

SMME - Small Medium and Micro Enterprise

TERMINOLOGY

Conceptual Policy View : Conceptual Policy Views are described as Key Sustainability Factors, applied toward an integrated and analysed view, for reference within a Directed Graph and resultant prototyped conceptual framework; as a related set of information technology policies to implement within South African SMMEs toward facilitating mutually beneficial sustainability for the elements namely 'Organisation', 'Environment' and 'Information Technology'.

Element: Elements are described as the contextual study topics or domains of this research study; which are endeavoured toward facilitating a sustainability goal of mutual benefit for. These elements specifically are: 'Organisations' of South African SMME type, the 'Environment' and 'Information Technology' as industry. The elements are entities that will as such sustain themselves and each other, in applying and/or adhering to suggested information technology policies, within their respective domains.

Environmentally Friendly: Environmentally friendliness is described as a state achieved via actions that will promote mutually beneficial sustainability; for South African SMME organisations, the physical environment and information technology as industry. South African SMME organisational information technology policies are suggested via a conceptual framework, toward achieving this state. The term may also be referred to as corporate greening or eco-friendly practices.

Key Sustainability Factor: Key Sustainability Factors are described as specific goals, per element, that are aimed at to be achieved, toward facilitating the accomplishment of mutually beneficial sustainability for these elements.

Key Sustainability Factor Enabler: Key Sustainability Factor Enablers are described as suggested information technology means, via which specific Key Sustainability Factor goals can be achieved; in implementing and adhering to such recommendations within South African SMME organisations.

Mutual Benefit: Mutual benefit is described as the result of achieving Conceptual Policy Views, via Key Sustainability Factor Enablers that adhere to their respective Key Sustainability Factors, for each of the study elements namely 'Organisation', Environment' and 'Information Technology', in the form of sustainability for South African SMMEs.

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APPENDIX

APPENDIX A1: LETTER OF INTRODUCTION

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Department of Informatics
Faculty of Engineering, Built Environment and Information Technology
Pretoria 0002 Republic of South Africa
Tel (012) 420-6321 Fax (012) 362-5287
http://www.up.ac.za

Letter of Introduction

Toward an Environmentally Friendly Information Technology Approach within South African SMME Organisations in Engendering Mutually Beneficial Sustainability

Research supervised by:
Dr. H.H. Lotriet
Landline: 012 420 3351
E-mail: hugo.lotriet@up.ac.za

Research conducted by:
Mrs. J. Wessels (20054328)
Cell: 084 603 3107
E-mail: janelle.wessels@gmail.com

Dear Organisation / Participant,

(Participant(s) from) your organisation is herewith **invited** to participate in an academic research study conducted by Janelle Wessels, Masters student, from the Department of Informatics at the University of Pretoria.

The **purpose** of the study is as outcome the provision of a framework constituting the most critical factors to consider/ adhere to, to be used by South African SMME organisations, in developing green / sustainable information technology polices.

Participation within this study will imply partaking in an **interview**, for each participant separately. Multiple suggested answers to the question, "What considerations, would you recommend as critical for consideration by IT practitioners aiming to develop and implement green IT policies; for use in a SA SMMEs context, based on what the IT industry advocates as being technically correct?", will be required to propose and motivate, in completing the interview.

Possible **benefits** that you as an organisation / participant may incur via taking part in this study, includes:

- Optional identification as research participant, within the research report and possible academic article to result
- Provided copies of the research report and possible academic article for reference use
- Possible learning opportunity for junior organisational representatives in participating in the interviews

Participants reserve the right to remain anonymous or be identified, among various other **rights**; as is set out and available for your perusal within the attached Informed Consent document.

Administrative **information** further to this interview pertains the setting of interview date and times as suited to interviewee schedules, a duration of approximately 30 condensed minutes of interview time, and Skype serving as call conferencing medium for this purpose.

I will appreciate your consideration of the above toward participating in the study. Should you / your organisation agree to participation; kindly confirm this by **signing** this document at the below provided and also complete the attached Informed Consent document. Should you have any questions or comments regarding the study, please feel free to contact either myself or my supervisor at the details provided above.

Date: _____

Organisation / Participant Name: _____

Organisation / Participant Signature: _____

Researcher: _____

APPENDIX A2: INDEMNITY FORMS

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Indemnity Form

Indemnity Form

Background Information

	Researcher	Supervisor
Name:	Mrs. J. Wessels	Dr. H.H. Lotriet
E-mail:	janelle.wessels@gmail.com	hugo.Lotriet@up.ac.za
Contact No.:	084 603 3107	012 420 3351
Study:	Toward an environmentally friendly information technology framework for South African SMME organisations, in engendering mutually beneficial sustainability via unbounded systems thinking.	
Objective:	The provision of a framework constituting the most critical factors to consider/ adhere to, to be used by South African SMME organisations, in developing green / sustainable information technology polices.	
Safety & Health Implications:	None.	
Duration of Participation:	Singular interview.	

Participant Agreement

- The participant retains the right to decide on participating within the study.
- The participant's privacy or dignity will not be violated using any data collection or recording means, without permission. Research devices and records will not be used without the participant's approval, and will not be applied in any disadvantageous ways.
- All information will be handled confidentially, and only data as approved for utilisation by the participant will be applied.
- The results of this study may be employed toward academic publication.
- The participant will be provided with a copy of the Indemnity Form, as well as have its content explained, before agreeing to participate in the study.

Participant Consent

I Warren Johnson voluntarily grant my permission for participation in the study, as explained to me by the researcher, Janelle Wessels. The participant agreement criteria, as set out within this document, is hereby consented to, based on my understanding of it according to the researcher's explanation of it to me. I hereby opt to participate within the study as an anonymous ☐ / identified ☑ participant and/or organisation ☐. I furthermore agree ☑ / disagree ☐ to the utilisation of a voice recording device throughout my participation in documenting the interview. Finally, all data ☑ / only data as specifically indicated for use ☐, throughout the study, may be utilised by the researcher within the research report.

Date: 12/March/2010

Participant: Warren Johnson

Researcher:

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Indemnity Form

Indemnity Form

Background Information

	Researcher	Supervisor
Name:	Mrs. J. Wessels	Dr. H.H. Lotriet
E-mail:	janelle.wessels@gmail.com	hugo.Lotriet@up.ac.za
Contact No.:	084 603 3107	012 420 3351
Study:	Toward an environmentally friendly information technology framework for South African SMME organisations, in engendering mutually beneficial sustainability via unbounded systems thinking.	
Objective:	The provision of a framework constituting the most critical factors to consider/ adhere to, to be used by South African SMME organisations, in developing green / sustainable information technology polices.	
Safety & Health Implications:	None.	
Duration of Participation:	Singular interview.	

Participant Agreement

- The participant retains the right to decide on participating within the study.
- The participant's privacy or dignity will not be violated using any data collection or recording means, without permission. Research devices and records will not be used without the participant's approval, and will not be applied in any disadvantageous ways.
- All information will be handled confidentially, and only data as approved for utilisation by the participant will be applied.
- The results of this study may be employed toward academic publication.
- The participant will be provided with a copy of the Indemnity Form, as well as have its content explained, before agreeing to participate in the study.

Participant Consent

I TIM JAMES voluntarily grant my permission for participation in the study, as explained to me by the researcher, Janelle Wessels. The participant agreement criteria, as set out within this document, is hereby consented to, based on my understanding of it according to the researcher's explanation of it to me. I hereby opt to participate within the study as an anonymous ☐ / identified ☑ participant and/or organisation ☑. I furthermore agree ☑ / disagree ☐ to the utilisation of a voice recording device throughout my participation in documenting the interview. Finally, all data ☑ / only data as specifically indicated for use ☐, throughout the study, may be utilised by the researcher within the research report.

Date: 23.02.2010

Participant:

Researcher:

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Indemnity Form

Indemnity Form

Background Information

	Researcher	Supervisor
Name:	Mrs. J. Wessels	Dr. H.H. Lotriet
E-mail:	janelle.wessels@gmail.com	hugo.Lotriet@up.ac.za
Contact No.:	084 603 3107	012 420 3351
Study:	Toward an environmentally friendly information technology framework for South African SMME organisations, in engendering mutually beneficial sustainability via unbounded systems thinking.	
Objective:	The provision of a framework constituting the most critical factors to consider/ adhere to, to be used by South African SMME organisations, in developing green / sustainable information technology polices.	
Safety & Health Implications:	None.	
Duration of Participation:	Singular interview.	

Participant Agreement

- The participant retains the right to decide on participating within the study.
- The participant's privacy or dignity will not be violated using any data collection or recording means, without permission. Research devices and records will not be used without the participant's approval, and will not be applied in any disadvantageous ways.
- All information will be handled confidentially, and only data as approved for utilisation by the participant will be applied.
- The results of this study may be employed toward academic publication.
- The participant will be provided with a copy of the Indemnity Form, as well as have its content explained, before agreeing to participate in the study.

Participant Consent

I Mummy Grecy voluntarily grant my permission for participation in the study, as explained to me by the researcher, Janelle Wessels. The participant agreement criteria, as set out within this document, is hereby consented to, based on my understanding of it according to the researcher's explanation of it to me. I hereby opt to participate within the study as an anonymous ☐ identified ☑ participant and/or organisation ☐. I furthermore agree ☑ / disagree ☐ to the utilisation of a voice recording device throughout my participation in documenting the interview. Finally, all data ☑ / only data as specifically indicated for use ☐, throughout the study, may be utilised by the researcher within the research report.

Date: 16/03/2010

Participant:

Researcher:

APPENDIX A3: INTERVIEW PREPARATION AND FACILITATION DOCUMENTS

Dear Participant,

Thank you for your participation in this study. Your views are regarded of high importance in determining the outcomes of this research.

Please consider the instructions to and completion of this document carefully, toward enabling the execution of a qualitative, short interview, based on it. Also kindly complete the attached Indemnity Form, according to which the researcher will be bound to protect both you and your organisation's privacy and data, as opted for within the form.

Should you have any queries with regard to this study or your preparation, do feel free to contact the researcher at the details listed below.

With Regards,

J. Wessels
Cellular: 084 603 3107
E-mail: janelle.wessels@gmail.com

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Interview Preparation & Facilitation Document

Technical Perspective

Research Background

The purpose of this research endeavour is to produce a *high level* conceptual framework, constituting the *most critical* factors to be considered by *South African SMME* decision-makers, in developing green and sustainable information technology *policies*; that will in turn facilitate the creation of a *mutually beneficial* sustainability relationship between the environment, South African SMME's and information technologies.

Interviewee Role

In order achieve the research purpose interviewee input is qualitatively required, in the form of information technology *recommendations for consideration* by South African SMME decision-makers, to regard in setting up such green and sustainable information technology policies.

General Recommendation Requirements

The recommendations provided by the interviewee need to comply with the following general requirements, in order to qualify as valid:

- A minimum 5and maximum of 10 recommendations is required.
- Recommendations must relate to *information technology* as enabling means toward sustainability.
- Recommendations may regard any suggestions that can be translated into organisational *information technology policy* e.g. practices, products, services, strategies, procedures or standards, in the form of e.g. principles, recommendations, focus areas, characteristics or criteria.
- Recommendations must represent those seen to be the *most critical* to the successful generation of green and sustainable information technology policies.
- Recommendations must *relate to* and *be feasible to implement* within South African SMMEs.
- Recommendations must constitute *currently* feasible and presently available factors.
- Recommendations may not explicitly promote any specific brands; but instead refer to *functions or specifications* sought after.
- Each recommendation must comply with a *minimum* of one sustainability parameter, for *each* of four groups of parameters provided, in qualifying as a valid recommendation; but interviewees are requested to *mention all* parameters per group to which each recommendation complies. The four groups with parameters are listed below.

Interview Preparation & Facilitation Document

	Environmental Sustainability Parameters
a	Aversion of pollution
b	Preservation of water
c	Management of renewal resources
d	Protection of biological and human diversity
e	Management of waste
f	Prevention of global warming
g	Conservation of energy

	Information Technology Sustainability Parameters
a	Green manufacturing
b	Green energy management
c	Green resources conservation
d	Green end-of-lifecycle
e	Green quarters
f	Green operations
g	Green regulatory compliance

	Organisational Sustainability Parameters
a	Environmentally friendly leadership
b	Environmentally friendly learning
c	Environmentally friendly culture
d	Environmentally friendly consumption
e	Environmentally friendly processes
f	Environmentally friendly products

	South African SMME Economic Goals
a	Financial health
b	Economic growth
c	Job creation
d	SMMEs Efficiency
e	Collaborative SMME networks
f	Enhanced international competitive capacity
g	Levelled playing field between large enterprises and SMMEs
h	Levelled playing field between rural and urban SMMEs

Specific Technical Recommendation Requirements

The recommendations provided by the interviewee *also need to comply* with the following specific requirements, in order to qualify as valid:

- Recommendations must be of a *totally objective* and *technical only* nature; thus having no regard for organisational policies or personal opinions.
- Each recommendation must be briefly *supported* via any one of the following means: data (classified, grouped, tabled, listed or graphed); models; optimisation theories; alternatives comparisons; scientific proof; technical reports; briefings; cost/benefit analysis; cause/effect propositions; reports; diagrams; process flows; specifications; or logical reasoning. Such *proof is requested* to be provided in hard copy or referenced by location for allocation by the researcher.

Thank you for your participation.

Interview Preparation & Facilitation Document

Interview Preparation & Facilitation Form: Technical Perspective

Kindly complete the below form according the above instructions, in preparation for your interview. In doing so the interview in itself will merely constitute a brief discussion on the motivations behind recommendations made. The interview preparation form will be collected during the interview session.

A) Interviewee Information:

What is your job title? _____

How many years experience do you hold within this or a similar role? _____

What qualifications, relating to green and sustainable IT, do you hold? _____

B) Green and Sustainable IT Recommendations:

Example:

Rec. No.	Recommendation	Complying Sustainability Parameters *(Select all applicable)*								Supporting Means
Ex.	Implement ISO 14000 Standards	Environmental	a	b	c	d	eX	f	gX	Reference: http://www.iso.org/iso/iso_14000_essentials
		Information Technology	a	bX	c	dX	e	fX	gX	
		Organisational	a	bX	c	dX	eX	fX		
		South African SMME	a	b	c	dX	e	f	gX	hX

Interviewee Recommendations:

Rec. No.	Recommendation	Complying Sustainability Parameters *(Select all applicable)*								Supporting Means
1 – 10 (each)		Environmental	a	b	c	d	e	F	g	
		Information Technology	a	b	c	d	e	f	g	
		Organisational	a	b	c	d	e	f		
		South African SMME	a	b	c	d	e	f	g	h

End of Interview Preparation Form
Thank you for your participation.

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Interview Preparation & Facilitation Document

Organisational Perspective

Research Background

The purpose of this research endeavour is to produce a *high level* conceptual framework, constituting the *most critical* factors to be considered by *South African SMME* decision-makers, in developing green and sustainable information technology *policies*; that will in turn facilitate the creation of a *mutually beneficial* sustainability relationship between the environment, South African SMME's and information technologies.

Interviewee Role

In order achieve the research purpose interviewee input is qualitatively required, in the form of information technology *recommendations for consideration* by South African SMME decision-makers, to regard in setting up such green and sustainable information technology policies.

General Recommendation Requirements

The recommendations provided by the interviewee need to comply with the following general requirements, in order to qualify as valid:

- A minimum 5and maximum of 10 recommendations is required.
- Recommendations must relate to *information technology* as enabling means toward sustainability.
- Recommendations may regard any suggestions that can be translated into organisational *information technology policy* e.g. practices, products, services, strategies, procedures or standards, in the form of e.g. principles, recommendations, focus areas, characteristics or criteria.
- Recommendations must represent those seen to be the *most critical* to the successful generation of green and sustainable information technology policies.
- Recommendations must *relate to* and *be feasible to implement* within South African SMMEs.
- Recommendations must constitute *currently* feasible and presently available factors.
- Recommendations may not explicitly promote any specific brands; but instead refer to *functions or specifications* sought after.
- Each recommendation must comply with a *minimum* of one sustainability parameter, for *each* of four groups of parameters provided, in qualifying as a valid recommendation; but interviewees are requested to *mention all* parameters per group to which each recommendation complies. The four groups with parameters are listed below.

Interview Preparation & Facilitation Document

	Environmental Sustainability Parameters
a	Aversion of pollution
b	Preservation of water
c	Management of renewal resources
d	Protection of biological and human diversity
e	Management of waste
f	Prevention of global warming
g	Conservation of energy

	Information Technology Sustainability Parameters
a	Green manufacturing
b	Green energy management
c	Green resources conservation
d	Green end-of-lifecycle
e	Green quarters
f	Green operations
g	Green regulatory compliance

	Organisational Sustainability Parameters
a	Environmentally friendly leadership
b	Environmentally friendly learning
c	Environmentally friendly culture
d	Environmentally friendly consumption
e	Environmentally friendly processes
f	Environmentally friendly products

	South African SMME Economic Goals
a	Financial health
b	Economic growth
c	Job creation
d	SMMEs Efficiency
e	Collaborative SMME networks
f	Enhanced international competitive capacity
g	Levelled playing field between large enterprises and SMMEs
h	Levelled playing field between rural and urban SMMEs

Specific Organisational Recommendation Requirements

The recommendations provided by the interviewee *also need to comply* with the following specific requirements, in order to qualify as valid:

- Recommendations must be of a *totally organisational* and *group only* nature, in the sense that all recommendations made must correspond to the interviewee's organisation's point of view on the topic in question; thus having no regard for technical considerations or personal opinions.
- Each recommendation must be briefly *supported* via an indication of the *single most probable* ethical basis upon which it was set by the interviewee's organisation. A list of eight normative ethical theories is provided below for consideration toward consequent selections.

	Ethical Basis Assumptions	
a	Relativism	There is no absolute or universal right or wrong; judgments should be made relative to the environment in which it occurs.
b	Universalism	What is right is right for everyone, everywhere; and what is wrong is wrong for everyone, everywhere.
c	Consequentialism	The consequence of one's judgement determines whether it was ethical or not, not the behaviour to achieve it in itself.
d	Utilitatianism	Good judgement is any judgement that increases happiness; pleasure or happiness is the only absolute moral good.
e	Deontologicalism	Views duties as absolute obligations that you must follow through with, regardless of consequences, personal feelings or inclinations.
f	Kantism	What's good for one is good for all; for a judgement to be morally right, one must will the judgement to be a universal law.
g	Egoism	All people judge out of self-interest.

Thank you for your participation.

Interview Preparation & Facilitation Document

Interview Preparation & Facilitation Form: Organisational Perspective

Kindly complete the below form according the above instructions, in preparation for your interview. In doing so the interview in itself will merely constitute a brief discussion on the motivations behind recommendations made. The interview preparation form will be collected during the interview session.

A) Interviewee Information:

What is your job title? _____

How many years experience do you hold within this or a similar role? _____

What qualifications, relating to green and sustainable IT, do you hold? _____

B) Green and Sustainable IT Recommendations:

Example:

Rec. No.	Recommendation	Complying Sustainability Parameters (Select all applicable)								Supporting Means (Select single most probable)							
Ex.	Implement ISO 14000 Standards	Environmental	a	b	c	d	eX	f	gX	Ethical Base	a	b	c	d	e	fX	g
		Information Technology	a	bX	c	dX	e	fX	gX								
		Organisational	a	bX	c	dX	eX	fX									
		South African SMME	a	b	c	dX	e	f	gX	hX							

Interviewee Recommendations:

Rec. No.	Recommendation	Complying Sustainability Parameters (Select all applicable)								Supporting Means (Select single most probable)							
1 – 10 (each)		Environmental	a	b	c	d	e	f	g	Ethical Base	a	b	c	d	e	f	g
		Information Technology	a	b	c	d	e	f	g								
		Organisational	a	b	c	d	e	f									
		South African SMME	a	b	c	d	e	f	g	h							

End of Interview Preparation Form
Thank you for your participation.

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Interview Preparation & Facilitation Document

Personal Perspective

Research Background

The purpose of this research endeavour is to produce a *high level* conceptual framework, constituting the *most critical* factors to be considered by *South African SMME* decision-makers, in developing green and sustainable information technology *policies*; that will in turn facilitate the creation of a *mutually beneficial* sustainability relationship between the environment, South African SMME's and information technologies.

Interviewee Role

In order achieve the research purpose interviewee input is qualitatively required, in the form of information technology *recommendations for consideration* by South African SMME decision-makers, to regard in setting up such green and sustainable information technology policies.

General Recommendation Requirements

The recommendations provided by the interviewee need to comply with the following general requirements, in order to qualify as valid:

- A minimum 5and maximum of 10 recommendations is required.
- Recommendations must relate to *information technology* as enabling means toward sustainability.
- Recommendations may regard any suggestions that can be translated into organisational *information technology policy* e.g. practices, products, services, strategies, procedures or standards, in the form of e.g. principles, recommendations, focus areas, characteristics or criteria.
- Recommendations must represent those seen to be the *most critical* to the successful generation of green and sustainable information technology policies.
- Recommendations must *relate to* and *be feasible to implement* within South African SMMEs.
- Recommendations must constitute *currently* feasible and presently available factors.
- Recommendations may not explicitly promote any specific brands; but instead refer to *functions or specifications* sought after.
- Each recommendation must comply with a *minimum* of one sustainability parameter, for *each* of four groups of parameters provided, in qualifying as a valid recommendation; but interviewees are requested to *mention all* parameters per group to which each recommendation complies. The four groups with parameters are listed below.

Interview Preparation & Facilitation Document

	Environmental Sustainability Parameters
a	Aversion of pollution
b	Preservation of water
c	Management of renewal resources
d	Protection of biological and human diversity
e	Management of waste
f	Prevention of global warming
g	Conservation of energy

	Information Technology Sustainability Parameters
a	Green manufacturing
b	Green energy management
c	Green resources conservation
d	Green end-of-lifecycle
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c	Job creation
d	SMMEs Efficiency
e	Collaborative SMME networks
f	Enhanced international competitive capacity
g	Levelled playing field between large enterprises and SMMEs
h	Levelled playing field between rural and urban SMMEs

Specific Personal Recommendation Requirements

The recommendations provided by the interviewee *also need to comply* with the following specific requirements, in order to qualify as valid:

- Recommendations must be of a *totally personal* and *individual only* nature, in the sense that all recommendations made must reflect the personal opinions of the interviewee only; thus having no regard for technical considerations or the interviewee's organisation's views.
- Each recommendation must be briefly *supported* via an indication of the *single most probable* ethical basis upon which it was set by the interviewee's organisation. A list of eight normative ethical theories is provided below for consideration toward consequent selections.

	Ethical Basis Assumptions	
a	Relativism	There is no absolute or universal right or wrong; judgments should be made relative to the environment in which it occurs.
b	Universalism	What is right is right for everyone, everywhere; and what is wrong is wrong for everyone, everywhere.
c	Consequentialism	The consequence of one's judgement determines whether it was ethical or not, not the behaviour to achieve it in itself.
d	Utilitatianism	Good judgement is any judgement that increases happiness; pleasure or happiness is the only absolute moral good.
e	Deontologicalism	Views duties as absolute obligations that you must follow through with, regardless of consequences, personal feelings or inclinations.
f	Kantism	What's good for one is good for all; for a judgement to be morally right, one must will the judgement to be a universal law.
g	Egoism	All people judge out of self-interest.

Thank you for your participation.

Interview Preparation & Facilitation Document

Interview Preparation & Facilitation Form: Personal Perspective

Kindly complete the below form according the above instructions, in preparation for your interview. In doing so the interview in itself will merely constitute a brief discussion on the motivations behind recommendations made. The interview preparation form will be collected during the interview session.

A) Interviewee Information:

What is your job title? _____

How many years experience do you hold within this or a similar role? _____

What qualifications, relating to green and sustainable IT, do you hold? _____

B) Green and Sustainable IT Recommendations:

Example:

Rec. No.	Recommendation	Complying Sustainability Parameters (Select all applicable)								Supporting Means (Select single most probable)							
Ex.	Implement ISO 14000 Standards	Environmental	a	b	c	d	eX	f	gX	Ethical Base	a	b	c	d	e	fX	g
		Information Technology	a	bX	c	dX	e	fX	gX								
		Organisational	a	bX	c	dX	eX	fX									
		South African SMME	a	b	c	dX	e	f	gX	hX							

Interviewee Recommendations:

Rec. No.	Recommendation	Complying Sustainability Parameters (Select all applicable)								Supporting Means (Select single most probable)							
1-10 (each)		Environmental	a	b	c	d	e	f	g	Ethical Base	a	b	c	d	e	f	g
		Information Technology	a	b	c	d	e	f	g								
		Organisational	a	b	c	d	e	f									
		South African SMME	a	b	c	d	e	f	g	h							

End of Interview Preparation Form
Thank you for your participation.

Thank you for your participation.