School of Information Systems

Green IT Model for Gulf Cooperation Council Organisations

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This thesis is presented for the Degree of

Doctor of Philosophy – Information Systems

of

Curtin University

November 2019

Declaration

To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgment has been made.

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

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Human Ethics (For projects involving human participants/tissue, etc) The research presented and reported in this thesis was conducted in accordance with the National Health and Medical Research Council National Statement on Ethical Conduct in Human Research (2007) – updated March 2014. The proposed research study received human research ethics approval from the Curtin University Human Research Ethics Committee (EC00262), Approval Number #...HRE2017-0470

Signature: .....

Date: 11/11/2019

Acknowledgments

First, I thank Allah, my God who continues to bless me by assisting me to finish this search with His innumerable blessings. Then I would like to thank my deceased parents for supporting me throughout my life, also my beloved wife (Bashaer) and my children (Dalal and Abdullrhman), my dear brother Abdullatif, and all my siblings for their patience and understanding during the long journey to complete this project. Thank you for your support during the difficult times when I had to focus on my studies.

I also wish to convey my appreciation of the King Salman scholarship program, for giving me the financial assistance enabling me to study overseas.

I am most grateful for the assistance, help, patience and encouragement of my supervisor, Dr Tomayess Issa, over the last four years. Dr Issa offered me guidance on publishing, guidelines on top publications, and ensured that I met the publication requirements. This research could not have been carried out without her assistance.

I would also like to thank Dr Theodora Issa and Professor Vanessa Chang for their assistance and help during my research. Dr Theodora Issa offered thorough, detailed feedback on my PhD that helped me to achieve my goal. Professor Vanessa Chang gave me guidance to develop key parts of this thesis.

I would like to convey my deep thanks and gratitude to my peers and friends who provided helpful suggestions and comments on my thesis. I am also grateful to participants in Gulf Cooperation Council (GCC) organisations who generously gave of their time and effort time and effort. Finally, my research colleagues in Unit 4 Technology Park have also provided me with an ongoing source of guidance and encouragement and have helped me maintain my passion for this venture.

Abstract

Environmental problems such as climate change, pollution, non-sustainable energy, resource depletion, and recycling of Information Technology (IT) devices are of great concern for both considered developed and developing countries. In addition, the unrelenting nature of IT development and implementation in the world of business has attracted great interest in its strategic as well as environmental impact. The literature indicates that enhanced IT sustainability would help improve business elements. It is equally important to maintain an environmental balance as business investors become more aware of the role of sustainability in business. IT has significant environmental impacts as well as making it possible for businesses to adopt sustainable and Green IT practices. However, despite its importance, Green IT is yet to be comprehensively researched in developing countries, especially in Gulf Cooperation Council (GCC) countries that support the widespread use of IT. In the case of the GCC, there is a great dependency on IT alongside a well-supported vision for sustainability. While many businesses in the GCC do apply some of Green IT methods, the only hope in sight for the GCC countries is the business vision for IT excellence along with a reasonably stable environment. This is especially important for the established businesses that are part of the vibrant economic sectors such as Tourism, Finance, and Technology that do seem to make more use of IT. The study has been limited to specific organisations, which use mostly IT resources in their day-to-day activities. The aim of this study is to develop a Green IT model that suits the needs of GCC countries, and to demonstrate how the Green IT model will be useful for IT departments in GCC organisations.

A mixed-methods approach that combines face-to-face interviews with a survey was implemented to critically assess the initial model that was derived from the literature review. The initial model results a Table 20 compare 19 factors that founded in the literature review. A total of seventeen high-profile managers from various well-established companies within the GCC region were asked several questions (depend on the interviewee's position) concerning their Green IT and sustainability activities. The research data was then evaluated to produce the initial draft of the Green IT and sustainability model. The interview data as well as the findings from the literature review provided the basis for the design of the questionnaire to be distributed to organisations within the GCC region. The data gathered via the survey were examined with Exploratory Factor Analysis, and the outcome was combined with the initial Green IT and sustainability model to produce the final model comprising Governance, Social and Cultural Factors, Information Technology and Green Management, thereby addressing the gap in this field of research that conduced from the literature review . The developed model explains that Green IT and sustainability are part of the grand plan of major organisations in

the GCC.

This research offers rules for actualizing maximum and sustainable use of IT in the GCC business space. It aligns with the vision of the GCC governments in aspiring to be at the forefront of ICT innovation and demonstrating environmental sustainability. Observations can be applied equally to all GCC countries that are highly dependent on IT for most of their activities.

Published work

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CHAPTER 1. INTRODUCTION

1.1 Background

Due to technological advances and financial consciousness, IT periodic reactive tasks have been superseded by more creative and pro-active roles within commercial organisations (Atkinson and McKay, 2011; Hsu, Tsaih and Yen, 2018). As a result of advancements in technology and corporate consciousness, the periodic reactive work of IT within corporate organisations has been substituted by a more strategic and proactive position (Atkinson and McKay, 2011; Brockhaus *et al.*, 2017; Cui, 2017). IT is now seen as a clear strategic activator to achieve organisational goals (Henfridsson and Lind, 2014; Whittington, 2014).

Investing in information technology has had more influence on a company's revenues than similar expenditure on advertising or research and development. However, the impacts of IT investments have been considerably more variable than investments in marketing and research and development (Smith *et al.*, 2012). IT investments may give organisations more opportunity for creativity and innovation because IT includes different techniques to accomplish tasks. Most organisations may already understand how to handle effectively their areas of advertising and research and development, but few have developed IT strategies (Melville, 2010; Smith *et al.*, 2012; Mingers, Mutch and Willcocks, 2013).

With a continuous rise in IT investment, managers are constantly seeking IT value by matching IT with investment and vice versa (Buchwald, Urbach and Ahlemann, 2014). This requires clear IT accountability descriptions along with implementing structures which can track the fine-tuning of IT and enterprises to a comparable frequency (Alvarez, 2008; Bokolo, Majid and Romli, 2018), which form the foundation for corporate IT management (Bokolo, Majid and Romli, 2018).

Currently, the world is facing a host of environmental issues at the moment. Temperatures are steadily increasing together with a constant rise in sea levels and more natural disasters (Gronlund *et al.*, 2018). The environment has given countries in the world serious cause for concern (Bunker *et al.*, 2016). From the Kyoto Protocol that was signed in 2005 by about 128 countries (Chuang and Huang, 2015) to the more recent Climate Conference that was held in Paris 2015 (COP 21) that united more than 190 countries (UNEP, 2016), most nations are now doing something positive to address climate change issues globally. Governments, as well as non-profit environmental organisations, are very much aware that fighting a long-lasting and effective environmental campaign against climate change issues without the

cooperation of businesses is almost impossible (UNEP, 2016). Organizations are expected to create a balance between financial profitability with environmental and social implications (Henney and Donald, 2006; Dubey and Hefley, 2011a). As such, Green IT entrenched in the governance of an organisation remains a key factor for ecological IT usage as well as IT implementation for all business practices that are environmentally sustainable (Thomson *et al.*, 2015).

While the literature reports on countless IT governance studies (ITGI, 2003; W. 'RP' Raghupathi, 2007; Aras and Crowther, 2008; Hardin-ramanan, 2016) with Green IT being assessed by different researchers (Erek *et al.*, 2009; Wabwoba *et al.*, 2013; Yunus *et al.*, 2013; Liu, 2014), very little has been put into action to see that both are merged in the developing countries that depend greatly on IT on the one hand and are extremely vulnerable to climate change threats on the other; GCC countries are one example for this research. The GCC visions have prompted their governments to focus more of their attention on better governance, excellence, and IT sustainability (Shayah and Sun, 2019).

However, there still seem to be significant gaps in the research on Green IT and sustainability within the GCC in section 1.3. The focus of this research is to merge the factors driving good governance, IT as well as environmental sustainability for formulating a sustainability and Green IT model. In section 4.1.2 in this research, it has been suggested that this particular framework will assist organisations in the GCC to maximise their value of IT business as well as maintain a sustainable profit.

1.2 What is Green Information Technology (Green IT)?

El Idrissi and Corbett (2016, 597) state that the development of Green IT can be observed by the increasing number of studies that it has attracted over the previous two decades, on both the effect of IT on economic problems and its position among alternatives to economic sustainability. Since every research has its Green IT direction and because the ideas of Green IT have broadened, numerous Green IT definitions have appeared.

- Murugesan (2008, 25) define Green IT as design, production, use and disposal of computers, servers and related subsystems such as displays, printers, storage devices and networking and communication systems in an efficient and effective manner with minimal or no environmental effect.
- Bose and Luo (2012, 65) define Green IT as the energy efficient and cost-effective management of IT resources.

- Chou and Chou (2012, 447) It has also been defined as the process of effectively and efficiently designing, manufacturing and using computers, servers and various other devices to minimize environmental damage.

Most Green IT definitions take environmental sustainability over the IT cycle into consideration, as shown in earlier definitions. Some writers are also distinguishing between Green IT and sustainable IT, which they call Green Information Systems (IS). For instance, Dedrick (2010) considers Green IT as a means to mitigate IT carbon pollution and Green IS as the use of IS for economic solutions. Similarly, Green IT is defined by Molla and Abareshi (2012) as greening for the manufacturing, use and disposal of IT devices, while Green IS refers to the implementation of IT for green business processes. However, there is still a powerful connection between Green IT and Green IS since both contribute to the position of IT for sustainable environmental businesses. Accordingly, this study combines both Green IT and Green IS practices under the term "Green IT".

1.3 Why Gulf Cooperation Council (GCC)?

The economies of the Gulf Co-operation Council (GCC) are highly sensitive to the adversity of climate change, marked by a fragile desert environment and dependence on oil export revenues as its prime source of income (Callen *et al.*, 2014). This necessitates the development of non-oil industries, since oil export revenues are threatened by the steps taken by other countries to reduce factors that contribute to climate change (Callen *et al.*, 2014; Abdelraouf, 2015). Furthermore, dependence on oil is an inevitable threat to the region's economic stability, making the economy susceptible to oil price fluctuations (Sultan, 2012). However, environmental sustainability is likely to be a major challenge as the GCC are well prepared to decarbonize carbon capture and sequestrating oil and gas production, to reduce final consumption through improved efficiency, and to develop sustainable alternatives to energy sources, either renewables or nuclear (Giacomo and Ferroukhi, 2014).

The urgency of having an appropriate and incremental response to the pressing challenge posed by climate change was discussed at the 21st Conference of the Parties (COP 21) held in Paris in December 2015 (Viñuales *et al.*, 2017). the 21st conference of the parties on Climate Change (UNFECC) reached a historic agreement to restrict global rises to less than 2C above pre-industrial rates on average global temperatures, and to pursue efforts to limit the temperature increase to only 1.5ºC above pre-industrial levels, believing that this would significantly reduce climate change threats and damages (Rogelj *et al.*, 2015). The Paris Agreement ratified in November 2016, compelled all parties to do their utmost to improve the

international response to climate change by nationally determined contributions (NDCs).

Now, the agreement has come into force, the main task for governments would be to turn the mitigation and adaptation goals into actual practice. The extent to which the various nations are exposed to climate change impacts may vary depending on the different national situations. Hence, it is important to address the climate change situation in the GCC countries; this will be highly challenging, since these countries are affected not only by the adverse physical impacts of the climate change, but also by the impacts of measures to reduce climate change and, especially, restrictions on fossil fuels (Giacomo and Ferroukhi, 2014).

The GCC countries also rely heavily on oil and gas export revenues, accounting for almost 30% of the estimated world crude oil resources and around one-fifth of the world's natural gas reserves (Callen *et al.*, 2014). In order to recognize their susceptibility to fluctuations in oil prices and their knowledge of the finite nature of oil and gas supplies, GCC countries have prioritized economic diversification or a reduction of their dependence on export revenues for fossil fuel, as well as the strengthening of their long-term policies regarding the economic contribution of non-oil sectors (Sultan, 2012; Hvidt, 2013; Callen *et al.*, 2014).

Therefore, in order to reduce risk of competing approaches and additional regulatory responsibilities and inefficient budget allocations in GCC countries, it is essential to incorporate adaptation and mitigation initiatives into national long-term development strategy (Mezher and Park, 2012; Callen *et al.*, 2014). This means that the reactions of the GCC countries to climate change impacts should be integrated into current policy and decision-making processes, not implemented as a new policy. Integrating climate action into domestic economic policies will help maintain the policy to at all stages. It needs cooperation among different players –federal, sub-national, local, government, private and civil societies– in order to enforce the action on climate change.

1.4 Governance

The notion of IT governance emerged in the literature in the latter part of 1990 as a consequence of the importance of aligning company operations with IT (Erturk *et al.*, 2004). In 1998, the IT Governance Institute (ITGI) was created by the Information Systems of Audit & Control Association (now ISACA), a well-known worldwide organisation established to promote best practices in information systems, and to assist companies to implement IT governance (Liu, Turel and Bart, 2019; Yoon *et al.*, 2019). Since then, the research literature has offered numerous definitions of governance. Most of them include IT management and IT supervision as a more accurate means of achieving business strategies (De Haes, Van

Grembergen and Debreceny, 2013).

As IT budgets start to increase significantly and IT project data become more difficult to monitor, it is recommended that businesses operate more carefully whenever they invest in any IT investment (Smith *et al.*, 2012). Ensuring excellent returns on the IT investment has a great deal to do with governance and IT accountability as well as a strong focus on aligning IT with company objectives (Bernroider, 2008). Lunardi, Macada and Becker (2014) mention that IT governance is therefore essential if businesses seek to discover optimal IT value along with higher profits.

Organizations will greatly benefit from adopting IT governance. Effective IT governance helps to ensure the alignment of IT with company objectives, as it has always assumed that company efficiency can only be enhanced if its IT helps to address its specific requirements (Huang, Zmud and Price, 2010; ITGI, 2011). As businesses come up with better ways to manage their IT, they are able to devise more effective IT plans and address business objectives more efficiently (R. Peterson, 2004).

Business and IT managers work together on IT matters for a way forward in terms of assisting business with the right tools and the other way around (Bart and Turel, 2010). The motivation behind IT investments is business value, which will ultimately increase profits as well as ensuring better IT risks management (W. ‘RP’ Raghupathi, 2007; Wilkin and Chenhall, 2010). So, implementing IT governance helps to enhance business performance (ITGI, 2011).

Many businesses in GCC countries are still not taking advantage of IT governance. As such, exposing GCC to the knowledge of IT governance has become necessary for optimising IT benefits for businesses.

1.5 Social and Cultural

After the technological revolution, society and culture changed in many countries. Social networking has its origins in the 1960s, when the first Internet and email facilities started to appear after an increased interest in computer networking (Andrews and Biggs, 2006; Hussain *et al.*, 2016). An achievement in the history of social networking was the development of the Usenet in 1979, which offers a worldwide debate platform for consumers to publish emails (Kaplan, 2012). In 1988, Jarkko Okarinen created the Internet Relay Chats (IRC), popularised by the increase in the use of home computers (Preece, Maloney-Krichmar and Abras, 2003; Riuz *et al.*, 2019).

The first social media website was SixDegrees, founded in 1997 to enable people to register

and communicate with someone else (Kasavana, 2010; Wu, Stewart and Liu, 2015). This was followed in 1999 by the appearance of the first blogging sites (Kasavana, 2010). Sites such as MySpace, LinkedIn, Flickr, YouTube, Facebook and Twitter were launched at the beginning of the 2000s (Skeels and Grudin, 2009; Pallis, Zeinalipour-Yazti and Dikaiakos, 2011). Several niche platforms, including Tumblr, Spotify, FourSquare, Pinterest, and Instagram, have been created due to social demand and business competition.

The terms ‘social’ and ‘cultural’ are often found in contemporary literature related to "Web 2.0," "social media" and "cultural change". The distinctions between these terms, however, are not well known or differentiated (Lenartz, 2012). The GCC countries have not been immune to the influence of technology, especially in terms of the emergence of new social and cultural values. Also, the GCC should keep pace with the enormous impact and level of change on the lives of their people from social media. Several GCC countries have taken concrete steps in the adoption of social media via government departments in meeting the tasks and interaction of the ministry with their people (Al-Badi, 2013).

1.6 Information Technology

In 2004, the word' Web 2.0' appeared as a title for the worldwide web, which enables consumers to generate and change contents jointly (Allen, 2017). Web 2.0 is a communication system that allows consumers to connect via apps and tools available via a joint system in a virtual location (Shang *et al.*, 2011). This is different from Web 1.0 which was a central server-based scheme that distributed information to private users through static websites. In reality, the only facility available to Web 1.0 consumers was access to information, whereas Web 2.0 offers numerous functions to consumers who can make contributions without requiring expert knowledge to do so.

The use of IT by organizations contributes to the achievement of business goals. These days, corporate IT reflects a fresh, environment-friendly approach to business operations. Green IT, as defined by Murugesan and Gangadharan (2012), is the practice and research of the production, design and use of servers and computers and associated subsystems such as printers, screens, processing and networking devices and communications with efficient and sustainable features, and nearly no harmful environmental impacts. Green IT includes two main parts: IT as, environmental conservation and an ecological response (Molla and Abareshi, 2012). In turn, it was claimed that IT increases company carbon footprints due to increased energy consumption and CO_2 emissions resulting from increased data requirements (Bengtsson and Ågerfalk, 2011; Malmodin and Lunden, 2016). With improved technology and better structures, over 50 percent of the energy used to power company IT can be avoided (Jenkin, Webster and McShane, 2011). As data centres grow in volume, a significant amount

of energy is required to deliver power and refresh the equipment (Pakbaznia and Pedram, 2009; Davies, Maidment and Tozer, 2016; Zhou, Fu and Yang, 2016).

Rapid technological advances also produce hazardous e-wastes that are not disposed of properly (Chen, Boudreau and Watson, 2008; Priya and Hait, 2017; Rehman, Iqbal and Nawaz, 2019). Hence, measures like better data centre designs, server virtualisation and recycling of e-waste should be adopted (Hammadi and Mhamdi, 2013). On the positive side, IT could be used to influence the adoption of business practices that are environmentally sustainable (Jenkin, Webster and McShane, 2011; Bossle *et al.*, 2016; Jansson *et al.*, 2017). For instance, IT can speed up environmental reporting and auditing, ensure communication of sustainable behaviour and encourage the adoption of cloud services as well as paperless offices (Murugesan and Gangadharan, 2012; Morioka, Evans and Carvalho, 2016). As business stakeholders are becoming more conscious of the environment, businesses have a responsibility to abandon poor practices and use IT in ways that are better for the environment (Molla, Cooper and Pittayachawan, 2011b).

However, businesses lack Green IT leadership, and Green IT knowledge is sparse (Chou and Chou, 2012; Wabwoba *et al.*, 2013). The absence of a strong Green IT focus in organisations is deplorable (Bose and Luo, 2012). This is particularly the case in developing countries, especially in the GCC where, despite some attempts made by governments to promote Green IT in businesses (Asif, 2016), research in the field is rare. Therefore, there is a need to explore the implementation of Green IT in GCC organisations to better understand their current Green IT initiatives and pave the way for recommendations to optimise their business IT potential for environmental sustainability.

1.7 Green Management

Businesses are expected to consider the environment just as equally as they consider their profits (Marker, Johnsen MS and Caswell, 2009; Smith and Sharicz, 2011; Brockhaus *et al.*, 2017). Unless all levels of management support business behaviours that are sustainable and value-oriented, honest environmental considerations will never be part of organisational strategies (Alänge and Steiber, 2009; Breuer and Lüdeke-Freund, 2014; Dyllick and Muff, 2015). Business managers are urged to demonstrate more concern for Green IT, as organisations fundamentally enforce IT governance to create earnings and increase environmental sustainability. This perspective is supported by Bose and Luo (2012), who incorporate IT in business accountability and increase the pressure on stakeholders to minimise company carbon footprints, and make it possible for IT governance and Green IT to

eventually be adopted.

Moreover, in order to improve business processes affecting business goals, it is critical that the implementation of Green IT guarantee sustainable business practices combining stakeholder expectations and cost-effectiveness (Unhelkar, 2012; Agarwal and Sharma, 2016; Braun, 2018). Notwithstanding, businesses are reluctant to adopt the Green IT model (Chen, Boudreau and Watson, 2008; Liu *et al.*, 2017; Shen, Zhang and Long, 2017). Green management will assist GCC organisations to achieve the necessary equilibrium between business goals and sustainable IT practices.

1.8 Research objectives and significance

This research is focused on developing a Green IT and sustainability framework that is suitable for organisations in GCC countries. The scope of this research has been restricted to specific organisations, which mainly use IT tools in their daily activities. Another element influencing Green IT is the business sector (Yunus *et al.*, 2013). Hence, for the purposes of this research, this study also targets three types of employees: managers, IT personnel and non-IT personnel.

The research is focused on building a reliable Green IT (GIT) model that is relevant for most organisations in GCC countries in terms of sustainability practices. The GIT is expected to suggest options to key GCC businesses to maximize their use of IT for growth and sustainability purposes. This is entirely in tune with the vision of GCC governments that includes increasing IT business advantages and transforming the GCC into an exceptional sustainability model. The research objective is briefly discussed in section 3.3.

1.8.1 The main goals of this study are to:

***Main objective*:** To develop a Green IT model that meets the requirements of GCC countries.

First Sub-Objective: To determine the attitudes of various stakeholders in GCC countries concerning the Green IT model.

Second Sub-Objective: To investigate how the Green IT model can benefit IT departments in GCC countries.

1.8.2 Research questions

To achieve the research objectives, three research questions were formulated which guide the construction of the proposed GIT model intended to assist GCC organisations to

implement their IT sustainably and efficiently:

Main Research Question: How can a Green IT model meet the requirements of GCC countries?

First Sub Research Question: What are the opinions and attitudes of various stakeholders in GCC countries concerning the Green IT model?

Second Sub Research Question: How can a Green IT model benefit IT department in GCC countries?

1.8.3 Practical research significance

It is anticipated that the findings of this research will assist companies to maximise their IT use in the long term; moreover, they will be relevant to the vision of GCC countries. Ramady(2012) states that as the GCC countries are all in the category of developing countries, they face certain challenges because of:

(1) their small size

(2) long distance from major markets

(3) over-dependency on international markets

(4) dearth of natural resources

(5) strong vulnerability to climate change risks

GCC countries are aware of these challenges, particularly their susceptibility to rises in global temperature and economic uncertainties. In order to develop environmental resilience and ensure a secure place in world markets, it is important that the GCC strategies focus on consolidating IT usage as well as reducing carbon footprints.

Expectedly, this has given rise to various strategy proposals. For instance, regarding, GCC governments believe that this technology can make business processes more efficient, creating extra resilience and competitiveness. Therefore, this study is significant for GCC governments and businesses, as the final GIT model and several recommendations will provide valuable guidelines on how IT can be implemented so that business value as well as GCC sustainability is improved. Section 3.2.2 explains in more detail the practical significance of this research.

1.8.4 Theoretical research significance

The theoretical importance of a research undertaking is seen in terms of its contribution to extant literature, understanding of the research domain, and the potential research avenues

that it suggests. Therefore, from the theoretical perspective, few conceptual models for Green IT and sustainability have been constructed for developing countries (as discussed in section 3.2). This is especially relevant for the GCC countries that have a high dependency on IT, and which are typical of an unexplored area of research. Thus, the GIT model contributes to the literature by providing useful explanations for the Green IT and sustainability of GCC businesses, along with suggestions for more sustainable IT use. This can be applied to all GCC countries that have similar strong dependency on IT. The proposed model contributes to the knowledge base for further studies that seek to improve the model with further investigation and testing.

1.9 Research method

This research has been guided by a pragmatic philosophy. It employs a mixed-methods approach that implements both quantitative and qualitative methods. The qualitative dimension involves numerous interviews and the evaluation of important data to further support the findings (Yin, 2003). The first step was the Green IT model obtained from a literature review. Interviews with managers who are high positioned in GCC organisations reps the major sectors ensued as the second approach. The findings of the interview data analysis have led to the first draft of the Green IT model. A survey was developed based on the first GIT model draft derived from the interview data and the literature review. The survey questionnaire was distributed among managers of large organisations in the GCC. The evaluation of survey data was carried out using Experimental Factor Analysis (EFA) and parallel test to confirm the factors. The observations enriched and triangulated the draft to produce the final GIT model.

1.10 Research Design

The research design, that is discussed in depth in section 3.4, is divided into two phases: the main qualitative method aimed at collecting Green IT and sustainability ideas and perspectives from the GCC viewpoint, by means of interviews with GCC managers. This initial phase of data collection will be used to determine the factors that are important to the effective implementation of Green IT and sustainable model in GCC. This is accompanied by a qualitative phase in which questionnaires are evaluated for further refinements and to ensure the rigor of the system. Figure 30 demonstrates the sequential design chosen for this research.

Due to its ability to provide detailed responses, the mixed-methods methodology which

incorporates qualitative and quantitative approaches was used (Peng and Annansingh, 2013). Interviews with managers with a larger sample of participants allows for more generalization of outcomes. This helped the researcher to verify the findings and to reinforce them and to obtain a rich overview of the study.

1.11 Thesis outline and structure

This thesis consists of six chapters, as outlined below:

Chapter 1 provides an overview of this research, along with discussions of the thesis framework.

Chapter 2 findings from a thorough analysis of Green IT and sustainability literature, and find gaps in the literature to justify the research, and results in the first version of the GIT model.

Chapter 3 examines different research methods before providing reasons and justifications to support the chosen research design. This includes an extensive section explaining the combination of techniques: qualitative and quantitative phases, that was adopted for this research. The data collection process and analysis of data from each phase.

Chapter 4 describes the interview process, stating the interview observations along with the result analysis to churn out the initial GIT model draft.

Chapter 5 discusses the survey method, and describe the questionnaire items, administers surveys and further examines for refine the final version of GIT model.

Chapter 6 summarises the research contributions, acknowledges the research limitations, makes recommendations, and suggests avenue for future research.

References and appendices conclude this work.

1.12 Chapter summary

Every organisation can efficiently use the advantages of IT in enhancing business value and enabling sustainable business processes via credible Green IT and sustainability. The objective of this study is to investigate the opinions and attitudes of GCC organisations regarding Green IT and sustainability through a conceptual model design (GIT model). This model does not only influence Green IT and sustainability, but establishes a framework comprising several suggestions for the improvement of IT business use and sustainability. To date, no other model has been developed for GCC organisations that depend strongly on IT. Transforming the country into an exceptional model of IT efficiency and sustainability is totally in line with the GCC goals. The research implements a mixed-methods technique, the qualitative part comprised interviews, while the quantitative data was derived from a survey. This is discussed in the next chapter. The following chapter presents the literature review, which reveals the research gap and shows the shortcomings of various models and constructs the enhanced model. In the first stage of this study, therefore, a literary review developed a conceptual green IT model which will be discussed in the next chapter.

CHAPTER 2. LITERATURE REVIEW

2.1 Introduction

The previous chapter introduced the research background of Green IT and sustainability and explained the present use of the research in the GCC. It explained how developing nations can continue to profit from integrating sustainability in their business sector. Also, the research question was developed, research design and methodology were outlined, and the planned study was formed. This chapter discusses critical areas in finding and justifying the research gap, as well as building the improved model.

For a long time, Information Technology has transcended the realm of being a regular organisational activator to becoming an integral business strategy tool (Mingers, Mutch and Willcocks, 2013). With IT emerging as a possible lifeline, it has become necessary to make the appropriate IT decision for the purpose of business success (Popovič *et al.*, 2012; Işık, Jones and Sidorova, 2013). However, organisational IT mishaps have become a norm and a cause for concern (Bart and Turel, 2010). Various surveys have shown that IT investment failures have been recorded at between 20% and 70% (ITGI 2008, 22)

This is not acceptable for businesses, especially nowadays when many companies have established all their processes using IT (Goosen and Rudman, 2013). Hence, senior executives and management boards cannot underestimate the impact of decisions concerning IT (Henney and Donald, 2006). This awareness has caused many organisations to place more emphasis on IT governance as a step to increasing business IT values (De Haes and Van Grembergen, 2009).

Another successful area of business IT is Green IT. Since businesses are now expected to play a significant role in contributing to a sustainable environment, the importance of IT in this regard cannot be overemphasised. Businesses should start greening their IT as well as exploring its potential for supporting behaviours that are environmentally friendly (Steg *et al.*, 2014). Sustainability commitments can only be achieved through good governance (Aras and Crowther, 2008). The inclusion of Green IT in the proposed IT governance model will assist in guiding businesses in their IT-related, decision-making processes.

This guide is particularly necessary for businesses in the GCC region. With sustainability and IT increasing rapidly in terms of strategic relevance, it is difficult for GCC organisations to move forward without IT to ensure increased productivity and meet environmental responsibilities. Hence, this research aims to address the misgivings about Green IT and sustainability so that large and dominant companies in the GCC can be better directed concerning IT decisions.

This literature review examines the current Green IT and sustainability models in order to identify gaps and provides a plausible justification for this research. Relevant models and significant processes are combined to create the initial Green IT and sustainability model that is the main outcome of the research.

2.1.1 Scope of the Literature Review

This literature review is designed to cover several key themes and to examine scholarly contributions to the growing area of Green IT and sustainability in general and to IT departments in particular, as a technological tool. The review examines 255 articles from ICT and Green IT specialist books, journals and web articles. Numerous reliable databases were accessed to accomplish the goals of the review. The most-commonly used databases include ScienceDirect, Pro Quest, Springer, Business Source Premier, Business Source Complete, and Emerald.

Keywords were used to search for relevant resources that were linked with Green IT and sustainability and GCC IT departments. Those that were related to Green IT and sustainability are "governance", "Social and Cultural" while key terms "Green Management", "Green ICT" and “IT sustainability” emerged from observations reported in the literature on responsible IT usage.

The keywords, “framework” and “model” were also included in the previous set of keywords so that already-established models for Green IT and sustainability models could be found. In total, about 400 articles were discovered. With consideration given to the Abstract, and the articles’ publication details, the number of articles was later culled to 180 depending on how relevant they were to the literature review. To ensure that the articles were quite recent, only those articles published between 2000 and 2019 were reviewed. Any of the articles that were not published during this time, but were nevertheless consulted, were valuable for definitions and theories or for sourcing the origins of key terminologies.

Many of the reviewed papers were published in highly rated journals including: Information and Management, European Journal of Information System, MIS Quarterly, International Journal of Accounting Information Systems, Journal for Information Technology, Journal for Information Systems and Information Technology and People.

Many other reports contributed equally relevant information to the literature review. Information on Green IT and the sustainability of GCC countries, such as frameworks and global reports, were generally obtained from the major organisations demonstrating best practices in IT. Statistics on IT’s ecological effects along with Green IT worldwide were

obtained from sources which include Gartner, The Climate Group, Symantec and CFO Research Services. Information about sustainability and IT in the GCC was sourced from national strategic plans, GCC reports, and published materials from IT departments in GCC countries. The World Bank national diagnostics also offered relevant information about the GCC economy and its major industries.

The remaining part of this chapter has been divided into various sections to ensure a detailed review of Green IT and sustainability. Section 2 presents various definitions of Green IT, and the sub-sections explain in detail the Governance, Information Technology, Social and Cultural and Green Management aspects. Then, current Green IT models and their benefits for Green IT and sustainability, are examined. Section 3 gives details regarding Green IT in GCC countries and the current business vision for each country. The vision review will focus only on sustainability and this region's plans for its implementation. Section 4 identifies the research gap and presents the proposed framework. The last section defines the scope of the research.

2.2 Definitional aspects of Green IT

Sustainability is the ability to create something to sustain or maintain itself (Moore *et al.*, 2017). Bonevac (2010) defines sustainability as being when individuals continue to do something over the long term. Historically, the term 'sustainability' first emerged in public policy in in 1987. Nevertheless, sustainability has taken on various meanings according to its application in various (Kuhlman and Farrington, 2010). Brundtland's definition is one of the most recognized concepts of sustainability: "Humanity has the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development 1987, 5). Extrapolating from all definitions, sustainability is the ability to continue using a resource without damaging the environment. The study demonstrates the four themes for each sustainable IT project that should be considered, these them are governance, social and cultural, information technology and green management.

While IT can contribute to the degradation of the environment due to its energy requirements and disposal issues, if used responsibly, it can benefit business environmental sustainability (Murugesan and Gangadharan, 2012). For instance, IT is supportive of behavioural changes which improve energy conservation and can be very instrumental in diffusing sustainability information to create a company culture which makes employees more aware and committed to ecologically sound IT ventures (Harmon and Demirkan, 2011). To ensure a more sustainable environment, businesses ought to make the best of ecological benefits as well as

minimising environmental impacts that could emerge from using IT – this notion is known as Green IT (Chen, Boudreau and Watson, 2008).

In the last ten years, interest in and implementation of Green IT has greatly increased amidst of other business concerns (Mohiuddin *et al.*, 2018). Unhelkar (2012) forecasts Green IT to be integrated into business processes optimisation by Chief Information Officers (CIO). Despite the important IT role in the sustainability challenge, it is still a young area of study (Mezher and Park, 2012; Yunus *et al.*, 2013; Deniz, 2016). Green IT is discussed further in the following subsections. Researcher discuss the background and the growth of Green IT and include Green IT tools. Implementation of Green IT models by IT departments is described, including the current techniques for implementing Green IT designs.

2.2.1 Green IT – History and Development

Dedrick (2010) sees Green IT as a means of reducing carbon emissions that are IT-related, while Green IS refers to the implementation of IS to address environmental issues. Similarly, Molla and Abareshi (2012) expressed their concept of Green IT as greening of IT manufacturing, use and storage, while Green IS applied IT to better and eco-safe procedures. Butler (2011) regards Green IS as the "Green IT-based Information Systems" for various ecological business purposes. However, the link between Green IS and Green IT is firmly established since they are both related to using IT for businesses that are environmentally sustainable.

Green IT became more common during the environmental movement and began to be implemented throughout the 1990s, making business processes or procedures more eco-sensitive. Many sectors, including manufacturing, automotive, metal, cement and electricity, started to incorporate environmental factors into policy-making from initial design to ultimate production (Starik and Marcus, 2000). In early 2000, in the press around the world, the word "green" appeared to be related to environmental practices. The green business then moved from an unidentified activity to a major activity for organisations. However, some green businesses have also achieved other advantages in previous phases of applying Green Methodology. Hence, the efforts of some of these new green businesses are known as window dressing or green washing (Ganesh, 2007). According to Boudreau, Chen and Huber (2008), Green IT and Green IS are now implemented in several business processes, which are major considerations in promoting sustainable economies around the world. The IT sector needs to focus on improving eco-effectiveness and decreasing energy consumption, as these are the problems faced by most IT departments. Green IT relies primarily on energy efficiency and

use of machinery; Green IS based on information management and design to improve the greening method (Boudreau, Chen and Huber, 2008).

As a result, the importance of Green IT first increased at the beginning of 2000, in line with the new technology revolution. New technology has caused massive damage to natural resources owing to the increasing global demand for updated technology. The disadvantage of using the latest technologies has been broadcast across the media by people and professionals concerned about environmental damage. However, not enough consideration is given to the ways that harm to the environment can be minimized. A BBC environmental report found that "manufacturing a 24 kg PC with a monitor needs at least 240 kg of fossil fuels to provide the energy and 22 kg of chemicals; Add to that, 1.5 tons of water, and your desktop system has used up the weight of a sports utility vehicle in materials before it even leaves the factory" (Hirsch, 2004, 1). These problems have led to the creation of new business models to decrease environmental damage and to improve productivity.

2.2.2 Relationship between Green IT and Sustainability

Ironically, IT could suffice as a solution, as evidence from the Organization for Economic Development suggests, successful IT environmental impacts fall into three stages (Berkhout and Hertin, 2000). At the initial stage, IT is supportive of environmental audits, monitoring as well as reporting (Chen, Boudreau and Watson, 2008; Murugesan, 2008). At the next stage, dematerialization which is a product of IT results in a reduction of materials used, combined with an increase in resource efficiency via behaviour-based changes like telecommuting, implementing paperless offices and energy efficient hardware (Erek *et al.*, 2009; Molla, Cooper and Pittayachawan, 2009). IT can contribute to sustainable attitudes at a much greater level that can provide excellent environmental efficiency (Gholami *et al.*, 2013).

The ICT solutions for the challenges of the 21st century forecast that Green IT has the capability to cut down carbon emission by a massive 20 percent by the year 2030, with ICT-produced emissions worldwide decreasing to 1.97% by 2030 in contrast to 2.5 percent by 2020 simply because of better energy efficiencies, considering the design of IT devices, and companies investing in ecological ICT (Global e-Sustainability Initiative 2015, 18). With natural resources becoming increasingly scarce, and the spike in prices, considering sustainability within corporate IT is essential for showing business readiness for resource stewardship, generating trust from more customers, suppliers and investors (Boudreau, Chen and Huber, 2008; Bose and Luo, 2012).

Many corporate businesses are already insisting that their partners commit to the green

concept, and customers expect businesses to expose their level of carbon impacts that influence companies' reputations as well as their shares and market value (Murugesan, 2008; Erek *et al.*, 2009). Green computing ideas also ensure compliance with the sustainable business plans (Beloglazov, Abawajy and Buyya, 2012), thereby providing extra business capabilities which include resilience (Watson, Boudreau and Chen, 2010), continuous competitiveness, and reduction in costs (Cai, Chen and Bose, 2013). Literature is also in favour of an increase in the overall firm and environmental performance, which is a product of green technology adoption.

Hence, as major business stakeholders seek sustainable partners, Green IT has become a strategic business necessity that governs the sustainable enterprise use of IT and the role of IT shifting from ordinary economic benefactors to sustainable enabler (Molla, Cooper and Pittayachawan, 2011a). Nevertheless, as pointed out subsequently, Green IT has its own challenges.

2.2.3 Green IT tools for the IT department

There is various Green IT tool available to all company departments to minimize environmental harm. However, this study will concentrate on tools that are particularly helpful to IT departments, such as cloud and computer virtualization. Virtualization means building a virtual computer rather than having a real physical machine; a virtual computer is normally used via the computer network. Cloud computing uses separate Internet-based software, which offers many advantages, including energy reduction, to run the software on the computer. There are also tools that can be used in all departments along with IT such as energy consumption reduction tools and the reduction of printing on paper. Training end users in the use of Green IT will also be an effective way to change people's thinking in regard to Green IT. End users will be given suggestions on how power and energy can be reduced by switching the computers off during non-work periods and decreasing the quantity of paper by using electronic storage.

Gartner's results show that the average IT department consumes 62% of a company's total energy supply (Gartner, 2008). The ICT community accounts for 2% of all carbon emissions globally (Gartner, 2008). Concentration on IT departments will therefore provide possibilities to decrease power and save money. Power management software is used to manage electrical installations as complex as office complexes or housing structures or as simple as a single computer, saving millions of dollars (Ruth, 2009). In addition, Dell has more than saved one million Dollars in power cost every year by reducing 26% of the electricity

requirements of its information centre using renewable power (Cogan, 2008).

In terms of manufacturers and sectors globally, developing nations lead the IT revolution. Thus, sustainable practices are essential in order to decrease the environmental impact, boost profits and create the distinctive character of organizations. Recently, IT has become a main variable in organizations having to satisfy their company requirements while using natural resources, such as energy consumption, and ensuring company viability. Implementing Green IT will thus assist these organizations decrease their economic carbon footprint.

2.2.4 Implementation of Green IT models in the IT department

Changing the working environment requires a consistent strategy to prevent mistakes. In the IT department, the implementation of the Green IT model is the task that better be addressed properly. One of the primary objectives is to decrease energy usage, that most of the Green IT technologies aim to achieve. GREENSOFT, for example, is a tool that assists developers, managers and customers to develop and use sustainable software (Naumann *et al.*, 2011). One of GREENSOFT's goals is to make sure the software code is set in a manner that decreases computer power consumption. Uddin and Rahman (2012) have also implemented a Green IT metrics system that reduces the power consumed by data centres by monitoring energy usage and utilizes green energy for production.

Green IT implementation could therefore be split into two categories: a technical part that relies mainly on energy usage reduction; and a theoretical part that shows consumers how to decrease harm to the environment. In addition, Power Use Efficiency is a metric that calculates the energy efficiency of an entire data centre and separates the energy produced by the quantity of energy entered in the information centre by the IT facilities. The number has to be less than one; therefore, the nearer the amount to one, the greater the energy efficiency. This tool is a Green Grid practice and is commonly used to evaluate the energy efficiency of a data centre (Van Heddeghem *et al.*, 2012).

2.2.5 Governance for IT

Governance in IT refers to any resource that includes Information Communication Technology that is needed to organise, analyse, save and distribute information. For this reason, the terms Information and Communication Technology (ICT) and IT are going to be used interchangeably in this research. Beyond rendering service, IT now attracts periodic strategic

partner attention (Tambe and Hitt, 2012). ICT benefits for increasing business and efficiency are becoming more obvious, resulting in IT investments that are strategically controlled and driven - simply to used IT in governance (De Haes and van grembergen, 2008). Encouraged by business/IT, investment and alignment research has impacts in the initial time, also IT in governance was a concept that emerged in the latter part of 1990 (De Haes, Van Grembergen and Debreceny, 2013).

Brown (1997) was the first researcher to critically investigate "IS Governance" solutions, which were later examined by (Sambamurthy and Zmud, 1999) who later discussed the notion of IT Governance. Ever since, the importance of IT governance has steadily increased. With its research and knowledge centre the main focus, the Institute of IT Governance (ITGI) (Steuperaert, 2008). Rubino and Vitolla (2014) states that ITG now has a place in the arena of corporate governance emergence, with management having to look closely at IT investments along with performance in relation to business needs.

The core of IT governance is also obvious for new IT business. In fact, Weill and Ross (2004) state that while many organizations have some type of IT governance, efficient ones have a number of processes for the establishment of enterprise / IT partnerships. IT decision accountabilities also recur in most of the definitions. Therefore, ITG is considered a mixture of strategic business IT processes and IT choice makers. For significant IT assets, governance measures are similarly evident. As a matter of fact, Weill (2004) stated that while some IT governance methods have been implemented by several businesses, they have effectively mapped many processes that improve company / IT partnerships in order to achieve company goals. Accountabilities in IT decisions is also seen in the majority of its definitions. ITG is regarded as responsible for both processes and IT decisions.

Good IT performance management is a key goal of IT governance. Successful IT management requires continuous monitoring of IT implementation to enhance it continuously (Cragg, Caldeira and Ward, 2011). This means assessing and monitoring IT efficiency from a clear financial perspective and non-financial indicators Including customer service, company report card and improved service quality. IT governance performance has criteria to be determine: IT uses cost-efficiency, applying IT successfully to growth, good use of IT to leverage assets and efficient use of IT to ensure versatility in market (Weill and Ross, 2004).

2.2.6 Social and Cultural effects on Green IT

The commitment to sustainability expressed both in the CSR report and social media channels of an organisation, can provide significant insight into the principles that underlie the culture of a company (Reilly and Weirup, 2011). Social media is among the very important facilities

that help individuals become greener. Recently, social media has provided various benefits, such as enabling individuals to exchange knowledge and opinions using computer systems. For example, creating a virtual meeting using social media will save individuals from traveling, decreasing transport and environmental harm. Many companies have actively used social media to transmit their projects for sustainable change (Reilly & Weirup, 2011). Moreover, social media has recently generated innovative business settings for consumers, reducing heavy costs for new businesses. The e-waste issue is a major concern for developing nations, and Green-IT provides possibilities and advantages in terms of financial, social and environmental terms for them (Hanne, 2011; Ainin, Naqshbandi and Dezdar, 2016).

2.2.7 Green Management

Green IT is not restricted to technologies involving energy efficiency, green data centres, cloud computing and computer virtualization. Green IT is also included in existing organisational policies and procedures, like management and e-waste (Harmon and Auseklis, 2009). For instance, Green IT organisations have a waste management program that uses discarded IT materials to be recycled by other IT agencies or sent to reuse operations. Adobe has developed a green solution to work with IBM to switch from traditional physical computers to fully virtualized and cloud-based computing as part of their new green management plan (IBM Green Report, 2012). Adobe removed more than 120 physical servers from its datacentre using five effective virtual IBM servers instead (IBM Green Report, 2012). This green approach will decrease damage to the environment and save more than $60 million over five years owing to cost cuts in energy charges, server servicing, and software license charges.

Management is therefore crucial after the implementation of a green model, in order to increase productivity and decrease environmental harm. Some organisations have already introduced Green IT strategies in their business operations.

2.2.8 Current problem with Technology

The current growth of industries is increasingly threatening the Earth's environment and natural resources which are affecting future sustainability. The economic and public expectations are putting pressure on companies to be completely responsible for operations of their businesses and to demonstrate ethical and environmentally-responsible behaviour (Chen, Boudreau and Watson, 2008; Bergmann *et al.*, 2013; Cai, Chen and Bose, 2013). Over

the last decade, initiatives have emerged focusing on the pursuit of sustainability of the environment and reduction of consumption of energy, calling into question our ability to establish a united global imperative that will respond to important issues arising from the global change of climate and conservation of natural resources (Kleindorfer, Singhal and Van Wassenhove, 2005; Olson, 2008).

It is not surprising that IT (information technology) has received great attention from practitioners and academics due to the important role it plays in environmental and energy issues (Bose and Luo, 2012). IT used to sustain the environment means conducting activities to utilize the positive effects and minimize the negative effects of people's behaviour on the environment through the use of IT and IT services and products throughout their life cycles (Elliot, 2011). It is a comprehensive concept which includes initiatives and efforts to use energy in a more efficient and effective way in order to make our environment more sustainable, as regards the use of IT. It is projected as the most significant strategic technology at present and for the future with paradox value (Thatcher and Pingry, 2007). IT has become a valuable strategic tool supplementing organizations' development in business as well as a weapon that unavoidably brings ecological, economic and social consequences with its high energy consumption and wastage (Bose and Luo, 2011).

Lately, a few researches have focused on energy consideration and sustainability of the environment and also emphasized the role played by IT services and products (Liu *et al.*, 2009; Corbett, 2010; Butler, 2011). In a latest survey report that covered 426 firms in North America and included firms all over the world totalling 1052, 86% of the firms said that it was significant/somewhat important their IT department implement IT green initiatives (Bose and Luo 2011, 39). However, based on the current literature, there is lack of research on IT for sustainability of the environment in GCC. The business practices in GCC organisations could be different from those of organisations found in developed countries in a number of ways in terms of sustainability and roles of Green IT. It is clear that there are variations between countries depending on how individual nations meet the sustainability requirements. For example, in New Zealand and Australia, the governments show strong support for sustainability, while the regulators in North America have a significantly smaller impact (Molla, Cooper and Pittayachawan, 2011b). Consequently, this research will investigate the role of information technology in addressing environmental and energy issues in the region of GCC.

2.3 Review of current Green IT frameworks and models

IT researchers are challenged by the extremely slow progress toward addressing environmental sustainability problems (Watson, Boudreau and Chen, 2010). Green IT research is not adequate as IT research pays little attention to this field (Dao, Langella and Carbo, 2011; Ardito and Morisio, 2014). Equipped with little guidance, organisations are still hesitant about committing to the Green IT initiative (Watson, Boudreau and Chen, 2010; Bose and Luo, 2011). Erek *et al. (*2009) and Bose and Luo (2011) called for further research into developing IT sustainability benchmark models. In order to find the research gap, in the next chapter, 17 current models that have IT as a main component, will be examined.

2.3.1 Teece model

The David Teece model (Teece, 2007) as shown in Figure 1, is a model that helps organisations, especially large organisations, to change their environment with minimal issues. The term that Teece used for this method is “Dynamic Capability”. This term was introduced by (Teece, Pisano and Shuen, 1997) in 1997. However, Teece extended this term to cover technological innovations. Teece, Pisano, and Shuen (1997, 516) defined Dynamic Capability as “the firm’s ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments”. The dynamic capabilities that Teece generated in the model are business agility, and the ability to (1) sense threats as well as opportunities, (2) seize opportunities, and (3) enhance, mix, protect and, if necessary, reconfigure the intangible and tangible resources of the business enterprise.

This model is widely used to implement Green IT concepts as it gives clear implementation concepts and steps, such as learning the common codes of communication and generating the organisational knowledge knows as “routines”. Therefore, the Teece model is not a particularly Green IT model, although this model has been successfully used to implement Green IT with minimal issues. “Teece's analysis of horizontal integration envisages governance costs and production costs as both being a function of an ‘index of the complexity of know-how’ in the firm” (Buckley and Strange 2011, 462) Therefore, the Teece model for Green IT is mostly used for governance and Green Management especially for innovations as shown in Figure 1.

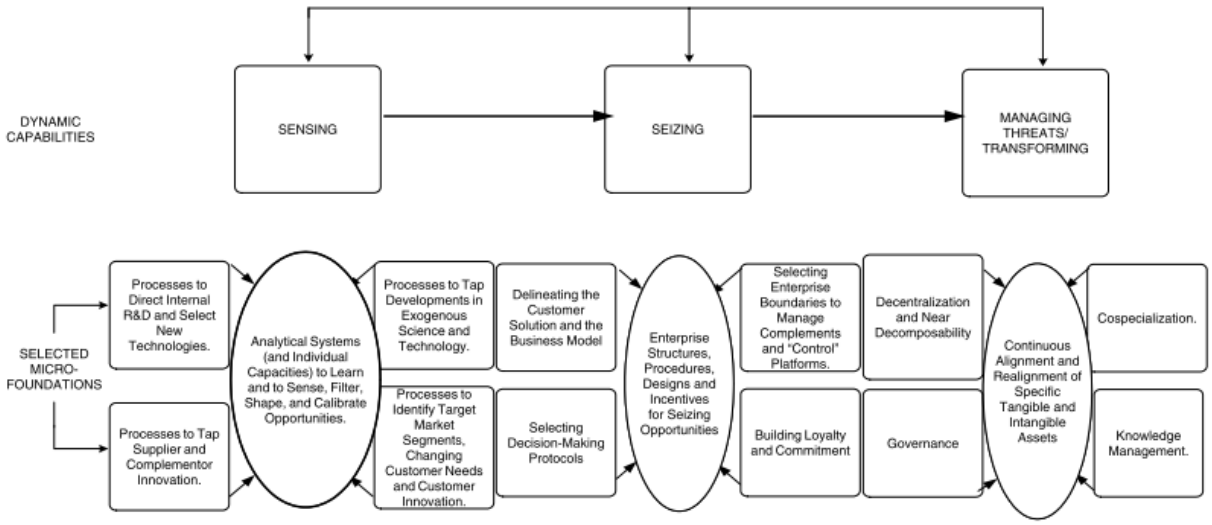

Figure 1. Teece model for dynamic capabilities and performance (Teece 2007, 1342)

Table 1. Generated factors from (Teece, 2007) (table developed by the researcher)

Governance	Information Technology	Social and Cultural	Green Management
Legal	**Smart-Tech** **Training**	**Social** **Cultural**	**Economic** **Environmental**

2.3.2 Ajzen model for planned behaviour

The Planned Behavior Theory (TPB) posits that external factors determine the individual's choice of behaviour. As shown in Figure 2, social psychologists have created and implemented the theory of planned behaviour, including health behavior, in order to understand different behaviours (Ajzen, 1991). This theory extends the commonly used reasoned action theory (Al-Suqri, 2015). The TPB states that behavioral proximal determinants are intended for the conduct and perceived behavioral control (PBC). PBC's expectation is that behaviour is understood and controlled by the person.

In sustainability, TPB is used in different fields and contexts. In sustainable business, the TPB model is widely used for design and to check the organisation's Sustainability Reporting. Also, it helps to predict the organisation's business direction by studying the planned purchase behaviour. A survey study by (Thoradeniya *et al.*, 2015) shows a that organisations' "managers belief sets (behavioural, normative and control beliefs) are positively related to their attitudes, subjective norms and perceived behavioural control, which in turn have an effect on managers' intention to engage in Sustainability Reporting (SR)". This is just one example of using the TPB model in Green IT, which while primarily social and cultural, is a main

component of research as shown in Table 2.

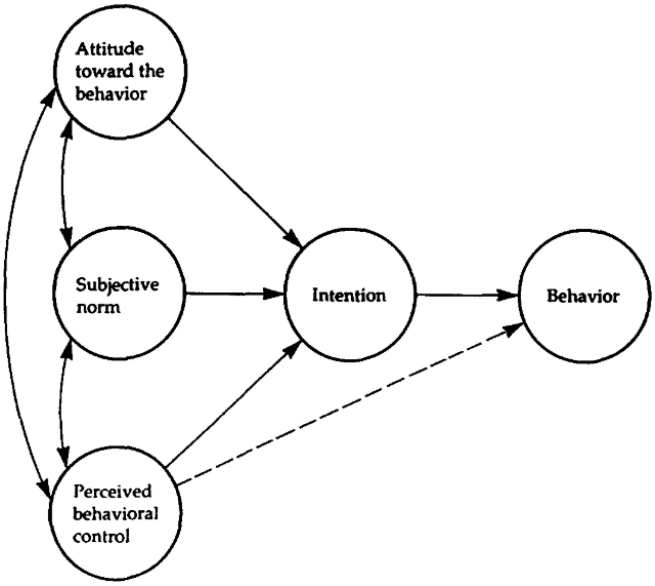

Figure 2. TPS model by (Ajzen 1991, 182)

Table 2. Generated factors from Ajzen model, (table developed by the researcher)

Governance	Information Technology	Social and Cultural	Green Management
No factors found	**Training**	**Social** **Cultural**	**Economic** **Environmental**

2.3.3 Soft Systems Methodology (SSM) by Peter Checkland (2000)

During the ’60s, Peter Checkland of the University of Lancaster in the United Kingdom, developed the SoftSystem Methodology model as shown in Figure 3 (Checkland, 2000). Initially, it was interpreted as some type of modelling tool; however, with time, this changed as it was later understood to be a learning as well as a development tool. While it is used to build models, these models are not cut out for the real thing, but by implementing system rules along with principles, real-world thinking can be correctly structured (Checkland, 2000; Rodriguez-Ulloa and Paucar-Caceres, 2005). The models are not normative or descriptive, although they comprise elements from both. One feature of SSM is that it limits the way to think as a means of expanding thinking. Hence, dispelling the notion that system-focused thinking is virtually expansive.

Like various systems, SSM’s core function seems to be to compare the world with the models of the world. Through this comparison, the world is better understood, along with ideas for improvement being discovered. Checkland offers several guidelines regarding what should be

added in terms of processes, structures, climate, people, challenges expressed by individuals, and conflicts (Rodriguez-Ulloa and Paucar-Caceres, 2005). Soft systems also implement "CATWOE" for listing situation perspectives that ought to be given due consideration to Customers, Actors, Transformation process, Worldview, Owner and Environmental limitations (Kotiadis, 2007). Therefore, in this research, the SSM model has five factors that will be address this research gap: which is legal, Smart-Tech, architecture, acceptance and environment as shown in Table 3.

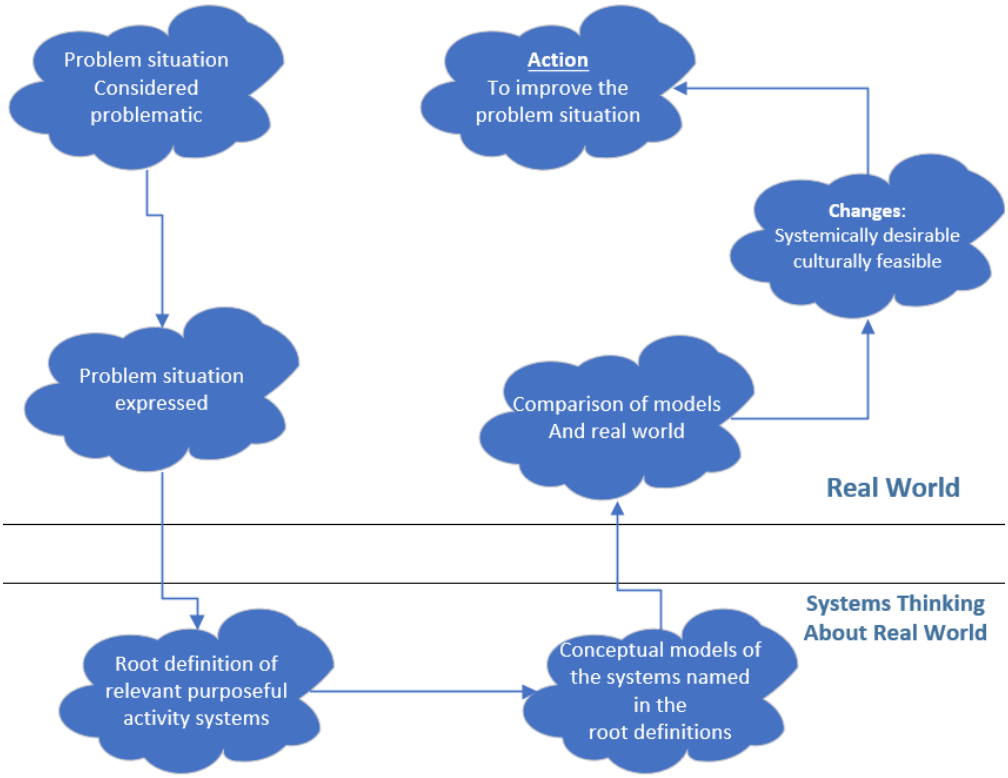

Figure 3. SSM model by checkland(2000), finger developed by the researcher

Table 3. Generated factors from Soft Systems Methodology model (table developed by the researcher)

Governance	Information Technology	Social and Cultural	Green Management
Legal	**Smart-Tech** **Architecture**	**Acceptance**	**Environmental**

2.3.4 G-Readiness Framework

G-Readiness, as shown in Figure 4, is the ability of an organisation to implement Green IT that is related to business processes such as IT water use, waste management, reduction of the supply chain and conservation of energy, ultimately generating economic benefits that are green-based (Molla, Cooper and Pittayachawan, 2011). In line with Molla, Cooper and Pittayachawan (2009), the G-Readiness framework assesses the organisation's environment when dealing with operations, IT acquisitions, systems, and waste disposal in order to ensure a steady improvement in sustainability. The G-Readiness framework hinges on five relevant factors that drive successful Green IT practices. Each element of G-Readiness is detailed in Table 4.

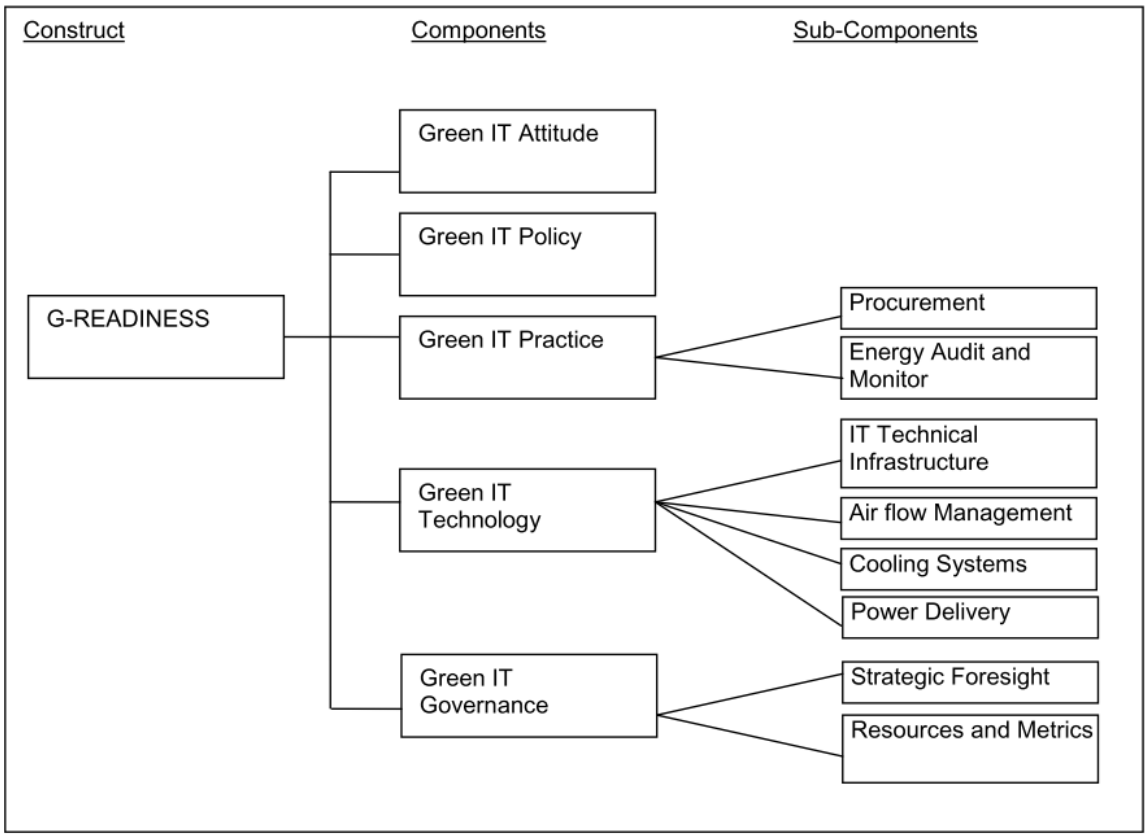

Figure 4. G-Readiness model by (Molla, Cooper and Pittayachawan 2011a, 84)

Table 4. The five elements of G-Readiness (derived from diverse sources as outlined in the table)

Element	Descriptive	Source
Attitude	Participating in Green IT endeavours to a great extent has to do with IT values and business values. Having	(Molla, 2009; Cooper and Molla, 2010; Bose

	such a mentality will help to understand threats to IT sustainability along with Green IT opportunities	and Luo, 2011)
Policy	The correct sustainability mentality is likely to produce efficient Green IT rules which can help direct sustainable behaviours throughout the life of IT resources, from purchases to activities and ultimately disposal. Policies show the stance of enterprises on Green IT for ensuring effective Green IT actions.	(W. Raghupathi, 2007; Murugesan, 2008; Chou, 2013)
Practice	It is not compulsory for actions to match, just as policies may not fuel actions. It is equally possible for companies to adopt Green IT endeavours in different ways. Green IT activities help organisations to evaluate how much consideration is given to sustainability when purchasing, utilising and disposing of IT equipment. These comprise Green IT criteria like energy consumption during IT equipment purchase, recycling of IT equipment together with cooling and data centre designs.	(Elliot, 2011; Molla, Cooper and Pittayachawan, 2011b; Chuang and Huang, 2015)
Technology	This factor gravitates more to green technology acquisition and development for promoting IT consumption that is energy efficient, cuts down IT carbon dioxide emissions, phases out equipment that emits a huge of carbon and monitors carbon emission.	(Elliot and Binney, 2008; Molla, Cooper and Pittayachawan, 2011)
Governance	Green IT ideas are propelled by the right amount of accountability, clarity, responsibilities and roles. Green IT procedures should be made formal, budget, as well as the IT contribution that ensures business sustainability, should be monitored as well as reported. Governance equally helps to establish Green IT and should the response to the environmental manager.	(Elliot and Binney, 2008; Molla, Cooper and Pittayachawan, 2011b)

Therefore, G-Readiness assesses an organisation's capabilities concerning Green IT, comprising managerial (policy and governance), human (attitude) as well as technical (practice and technology) angles, providing a reference for formulating effective strategies for steady Green IT ideas (Molla, Cooper and Pittayachawan, 2009). Nevertheless, the main focus of the framework is ecological IT, thereby failing to adequately consider the possibility of using IT to create enhanced sustainability within business practices (Buchalcevova, 2015). Approaches or instructions may help organizations to adopt Green IT as part of this structure, and IT

governance does not address it. This model is widely used due to the benefits that it offers for organizations, especially in developing Green IT. This research has been inspired by this model's nine factors: policies, legal, smart-tech, architecture, support, metrics, acceptance, CSR and environmental as shown in Table 4.

Table 4. Generated factors from G-Readiness Framework (table developed by the researcher)

Governance	Information Technology	Social and Cultural	Green Management
Policies **Legal**	**Smart-Tech** **Architecture** **Support** **Metrics**	**Acceptance** **CSR**	**Environmental**

2.3.5 GITAM

GITAM stands for Green Information Technology Adoption Model. The model described in Figure 5 is based on what is discussed below.

Green IT Adoption and Adoption Intention

Molla (2008) distinguished between actual Green IT adoption and the intention to do so. This has become necessary since new studies show that even when companies show concern about their environment and wish to do something, that does not mean they have taken any concrete actions yet (Esty *et al.*, 2006; Olson, 2008).

Drivers of Green IT

Molla (2008) mentions three factors that drive Green IT. They are:

- Economic drivers – This is all about better efficiency in IT as well as the goal of saving cost from various IT operations.
- The Regulatory driver is legitimacy pursuit within a broader social context.
- The ethical driver is the act of trying to actualise best business practices as well as corporate citizenship.

Green IT Context

Green IT context relates to the elementary adoption characteristics that context is hidden, while it can be relatively assessed objectively. This Green IT context comprises: Organizational context, Technological context, Green IT preparedness, Environmental context.

Green IT preparedness

This captures a flexible evaluation of a company's own as well as environmental readiness for

accepting Green IT. It covers the perceptual features of its adoption context.

Green IT Awareness

Going green has been a hype in the IT industry and it will be unwise trying to go beyond that when defining an organization's strategy for corporate social responsibilities. Going green also provides opportunities to cut down energy consumptions, as well as reduce CO_2 emissions. Molla (2008) states that cutting costs is paramount given the current state of things economically.

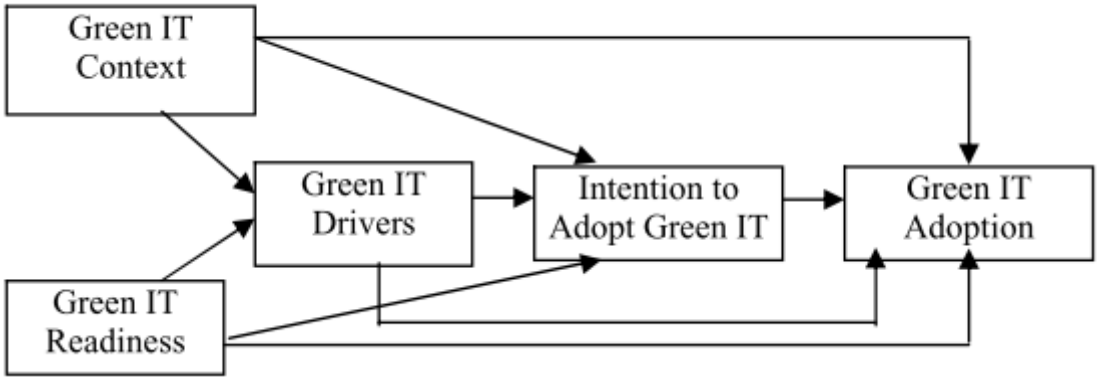

Figure 5. GITAM model layout by (Molla 2008, 660)

This research has discovered ten factors from this model which are: are policies, legal, smart-tech, architecture, support, monitor, metrics, acceptance, CSR, environmental and E-waste, as shown in Table 5.

Table 5. Generated factors from GITAM Model, the table developed by the researcher

Governance	Information Technology	Social and Cultural	Green Management
Policies	**Smart-Tech**	**Acceptance**	**Environmental**
Legal	**Architecture**	**CSR**	**E-waste**
	Support		
	Monitor		
	Metrics		

2.3.6 Green IT value

Green IT value is a model developed by Chou and Chou (2012) that is used to determine the value of Green IT. As shown in Figure 6, businesses are expected to firstly acknowledge the usefulness of Green IT before changing that knowledge into initiatives for Green IT that should be tracked and enhanced to get better Green IT success that will yield environmental sustainability. While this model introduces a straightforward path for implementing Green IT, it lacks any approach for Green IT. However, it specifies Green IT monitoring endeavours by establishing constant and metrics measurement, although more IT governance guides are not available. However, awareness is one of the concerns of this research, and the model shows a clear path toward achieving Green IT value starting from awareness.

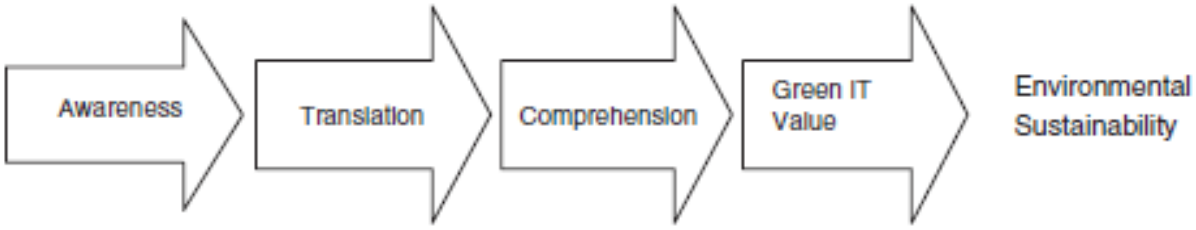

Figure 6. Green IT value model by (Chou and Chou 2012, 449)

This research has discovered six factors that will be included in the improved model. These factors are: legal, hardware, metrics, acceptance, economic and environmental as shown in Table 6.

Table 6. Generated factors from Green IT value Model (table developed by the researcher)

Governance	Information Technology	Social and Cultural	Green Management
Legal	**Hardware** **Metrics**	**Acceptance**	**Economic** **Environmental**

2.3.7 Green IT Campus Model by Monroe Community College's (MCC's)

Based on Oludele, Malasowe and Onuiri (2013), Monroe Community College designed a framework suitable for a Green IT Campus Model. The proposed MCC Green IT Campus Model has four components as shown in Table 7.

Table 7. The main four group to the MCC's Model

Power Consumption	• Buy printers, PCs, as well as other accessories (for computer labs, offices, libraries, classrooms) that comply with EPA's Energy Program or even EPEAT. • Handle virtualisation of the servers as well as data centre power use and the related HVAC (ventilation, air-conditioning and heat) challenges • Provide auto-controls on your data projectors as well as bulbs within smart spaces, conference rooms and campus meeting.

Recycling	• Use recycling software for
	  ○ Monitors, PCs and accessories (enter into a partnership with vendors) mobile devices
	  ○ Toner
	  ○ Batteries
	  ○ Baled and Shredded paper
	  ○ Outdated software CDs
	• Implement packaging that comes with the delivered technology, like cartons, plastic, Styrofoam, that could be re-fashioned for laboratory experiments when green matters are designed within the curriculum.
	• Use paper that has been recycled for printing and copying.
	• Address strategies to reduce the use of papers throughout the institution to provide better training for end users to print only one page from websites and emails.
	• Use imagery systems to decrease the number of hard-copy files to keep.
	• Get recommendations from retention experts and campus records to identify measure which may cut down hard copy that is college-related and the required space for retaining the files.
	• For certain library journals a special process should be made available to other libraries to help cover collection gaps.

Transportation & Fuel Conservation	Web courses (blended and asynchronous) reduces the necessity for students to always drive down to campus for lectures. • Implement videoconferencing for campus sites is capable of reducing travel and saving time for administrators, faculty and staff.

	• Using webcasts, audiocasts and webinars for developing professionally can cut down travel expenses as well as save time for staff, administrators and faculty. • Implementing enterprise based online transactional and information applications (like Banner) lets for online passage to student records and services, in registering for any course, completing an application for Housing, to view grades and schedules, etc. • Implementing enterprise based online transactional and informational applications lets for web access to records in campus and shortens staff, administrator and faculty travel to other campus sited during weekends and evenings. • Implementing Virtual Private Networks lets staff, administrators and faculty to easily access electronic files with zero travelling to campus at nights and on weekends.

Other Campus IT Sustainability Items	• The use of integrated electronic mail delivered by pay stub decreases postage costs and paper wastage.
	• Implementing integrated apps for reporting (i.e., WebFocus and e-print) saves up paper and offers time savings whenever you are in search of records online.
	• Using online timesheets cuts down using of paper, offers 24hrs access to inputs and timesheet approval, reducing the essence of traveling to a campus site for signing hard copy timesheets.
	  ○ Implementing pay-for-prints systems may cut down frivolous or unnecessary printing – such as people asking for printed copies that they end up not collecting, submitting one single print job severally, or printing of different pages and skipping the real page.
	  ○ Creating department-focused records saving schedules is important for retaining only the necessary records.
	  ○ Using microfiche records which should be legally binding for the institution decreases required storage space and keeps record retrieval in the future.
	  ○ Change alkaline battery flashlight with emergency rechargeable flashlights.

This research has discovered a number of factors from this model, these factors are smart-tech, hardware, software, support, monitor, metrics, social, cultural, acceptance, economic, environmental, and e-waste as shown in Table 8.

Table 8. Generated factors from MCC's Model, the table developed by the researcher

Governance	Information Technology	Social and Cultural	Green Management
No factors found	Smart-Tech Hardware Software Support Monitor Metrics	Social Cultural Acceptance	Economic Environmental E-waste

2.3.8 GREENSOFT Model

The GREENSOFT Model represents a concept-based model for "Green and Sustainable Software", that has the goal of supporting administrators, software developer and the end-users in developing, maintaining and the using of software sustainably. The model in Figure 7 consists of an entire lifecycle framework for various stakeholders, along with action recommendations coupled with tools for supporting stakeholders in creating, purchasing, supplying and then using the software greenly and sustainably.

This model comprises Software Products in its life cycle. This means that, unlike traditional software life cycles, it is channelled towards life cycle thinking (LCT), following the concept of "from the cradle to the grave". LCT has the goal of evaluating social, ecological, human as well as the product's economic compatibility within its lifetime. It starts with the initial product development stages and ends with the disposal as well as recycling of the product. The findings from these evaluations can be implemented for optimising the product or running a product comparison with its competitors.

The other section of the GREENSOFT' Model is known as Sustainability Criteria & Metrics. It handles common metrics as well as criteria for rating software quality (SQuaRE, 2005), also allowing a grouping of criteria as well as metrics for knowing the sustainability of the software product.

The Procedure Models ensure it is viable to group process models that take care of software acquisition as well as development, IT systems maintenance, and user-based support. As an instance, the researchers proposed a general extension for software development. Processes that are ambiguous, which enables the consideration of sustainability during the development

of software (Naumann, Kern and Dick, 2014).

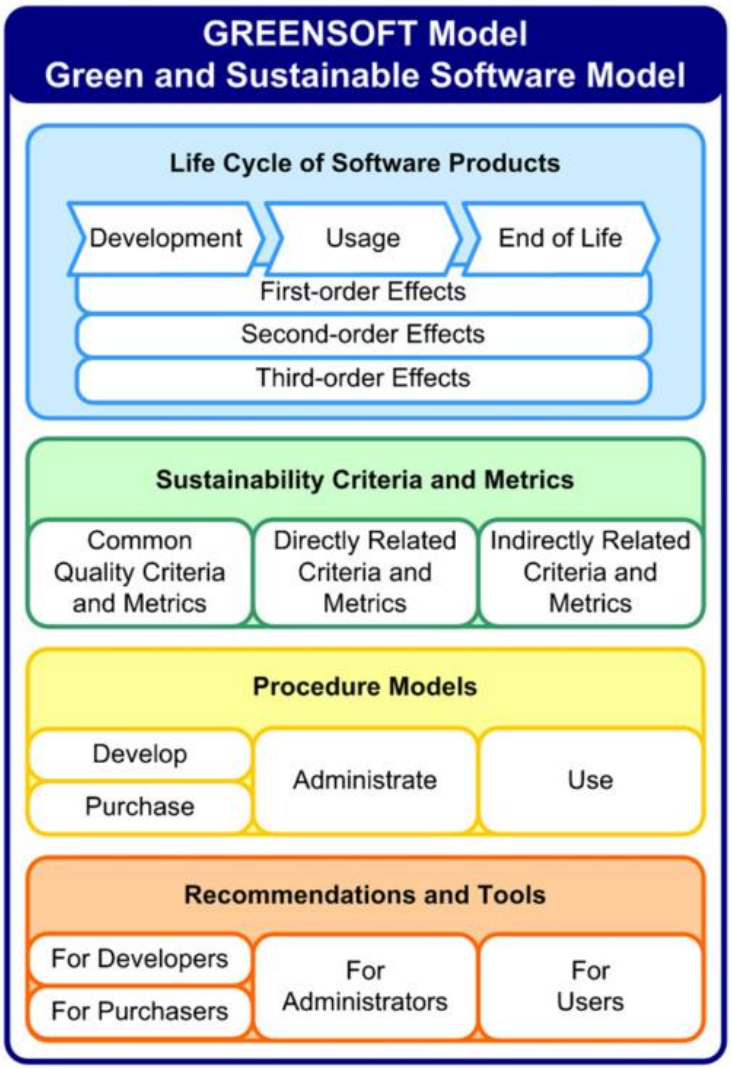

Figure 7. GREENSOFT Model by (Naumann *et al.* 2011, 297)

The very last component of the model comprises Tools and Recommendations. These help to support stakeholders with various professional skills in ensuring sustainable or green techniques generally when purchasing, developing, administrating or implementing software products. The possible roles include software developers, software acquirers, administrators and private and professional users (Dick, Naumann and Kuhn, 2010; Wang et al., 2016).

This research has discovered six factors from this model: software, training, support, monitor, metrics and environmental as shown in Table 9.

Table 9. Generated factors from GREENSOFT Model (table developed by the researcher)

Governance	Information Technology	Social and Cultural	Green Management
No factors found	Software Training Support Monitor Metrics	No factors found	Environmental

2.3.9 Model for Reducing Power Consumption by Enokido *et al*

The system was created for the reduction of peer-to-peer power consumption as shown in Figure 8. The model therefore concerns P2P schemes where peer machines are obviously heterogeneous and fully dispersed without centralized coordinators (Montresor, 2004; Enokido, Aikebaier and Takizawa, 2010). It is impossible for someone else to turn off a computer. A server peer provides some services for additional peers. A client peer will issue a server-based peer request. Every client should find a server that not only satisfies service requirements, but also uses less electricity. Transaction-base and transmission-based applications are the two types of applications available for this process. In transaction-based applications, a client-based peer will request a server-based peer to process the application with the server peer, for example by encoding multimedia content within web pages. Web apps serve as perfect examples. A server-based peer, on the other hand, will communicate a huge volume of data to a client-based user, such as FTP apps. In this research, the top P2P overlay network includes a Web app.

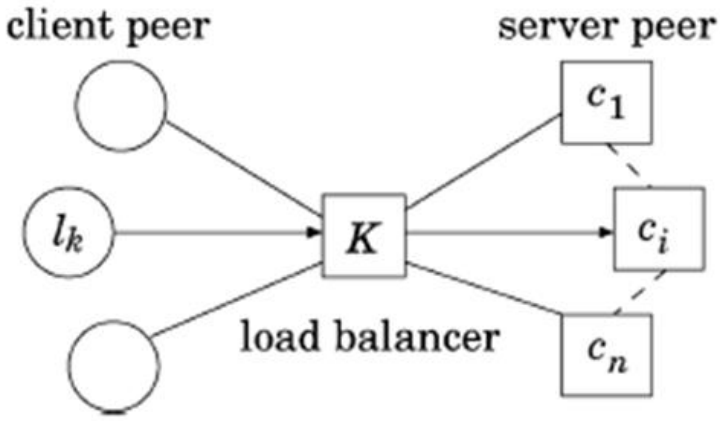

Figure 8. Reducing Power Consumption Model by (Enokido, Aikebaier and Takizawa 2010, 222)

The model suggested the computational model as well as the power consumption models for indicating how much power is consumed by a typical web request process. In the field of the CLB and PCLB algorithms for choosing a server are set, so the constraints will be met, with a reduction in total power consumed due to laxity concepts. The model assessed the algorithm based on power consumption processes compared against elementary RR algorithm. The model can cut down the overall server power consumption with the CLB and PCLB algorithms than in RR algorithm. The overall power consumption for servers in the PCLB algorithm is minimal. Therefore, the PCLB algorithms turn out to be very useful. Then, now consider application types such as file transfer as well as measurement of power consumption for several CPU servers.

In this research, five factors have been selected to be examined in the initial model. These factors shown in Table 10.

Table 10. Generated factors from Enokido et al Model (table developed by the researcher)

Governance	Information Technology	Social and Cultural	Green Management
No factors found	**Smart-Tech** **Hardware** **Software** **Monitor**	**No factors found**	**Environmental**

2.3.10 Conceptual view of the sustainability planning model

The model shown in Figure 9, indicates several capacity building pointers (i.e. structure type as well as formal linkages, innovation champions, good leadership, administrative policies & processes, resources and expertise) which need to be looked into if innovations are to be sustained (Johnson et al., 2004). There are also called causal factors, since they are features or attributes of an innovation which increases its potential so it can be sustained. The innovation features include aligning with needs, optimistic relationships within crucial users, successful use and success in a target prevention system, as well as ownership by those prevention system players. An appropriate sustainability action method is put in place based on it.

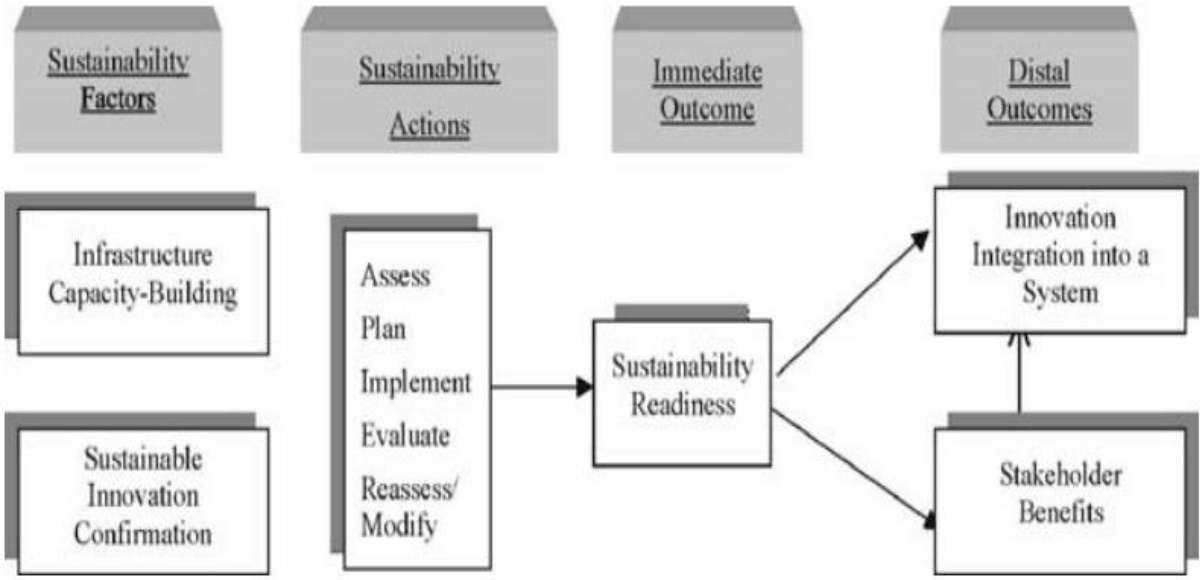

Figure 9. Conceptual view of the sustainability planning model by (Johnson *et al.* 2004, 138)

Infrastructure building capacity and innovations that are sustainable comprise a five-stage process: assessment, planning, implementation, evaluation, the reassessment and modification if it is required as shown in Figure 10 (Johnson et al., 2004). The level of success of the sustainability-driven actions yields immediate results, which is called sustainable preparedness; this includes adequate infrastructure, and a sustainable innovation that has been confirmed.

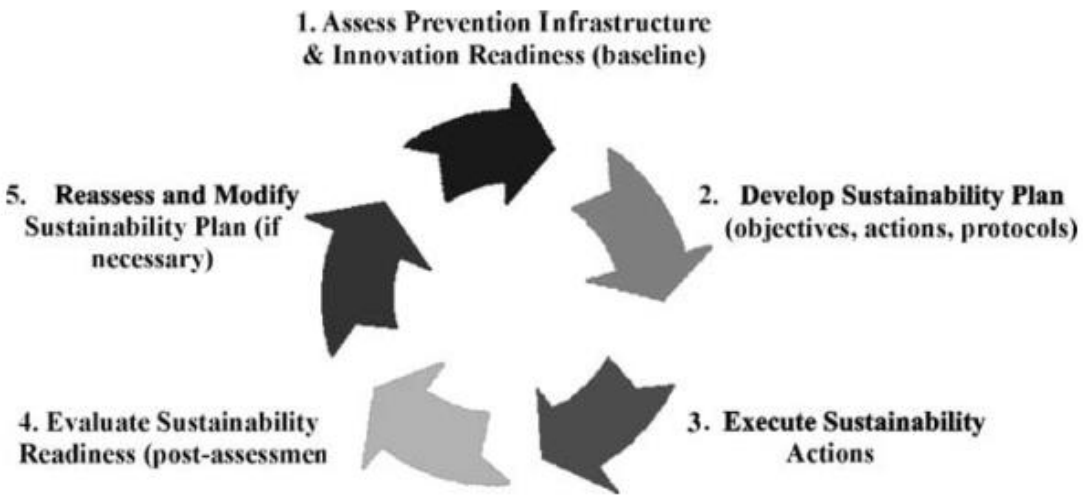

Figure 10 Sustainability stages process (Johnson *et al.* 2004, 145)

Moreover, the adequate preparedness level will cause distal outcomes that measure sustainability. These very outcomes include (a) innovation integration (prevention program, infrastructure or strategy) into the usual operation of a certain prevention system at various levels, (b) crucial stakeholders (decision maker considering infrastructure innovations as well as citizens in innovation prevention cases) benefits gotten due to the innovation. Innovation integration and stakeholder have a reciprocal relationship, with every outcome affecting the other one.

This model has several useful factors that need to be considered. These factors are shown in Table 11.

Table 11. Generated factors from sustainability planning Model (developed by the researcher)

Governance	Information Technology	Social and Cultural	Green Management
No factors found	Smart-Tech Architecture Hardware Training Monitor	Social Cultural Acceptance	Economic Environmental E-waste

2.3.11 Green Productivity Improvement Model

The model proposed by (Darmawan, Martini and Rahmanto, 2014) as a Green Productivity

idea (Figure 11) was introduced by the Asia Productivity Organization. An initial analysis was conducted to understand the situation and determine the possible components and subcomponents appropriate for institutionally based analysis.

The research centres and the complication of flexible supply chains in the institutionally-based structure can result in poor productivity, poor quality and negative environmental impacts. The said analysis made use of Interpretive Structures Modelling, that was derived from the Saxena development model and its special uses in the rubber industry (Marimin et al., 2014; Poduval, 2015). The ISM technique has two functions: hierarchy construction subcomponent grouping. The process was analysed with the Bokar process as well as raw material requirements.

It was conducted by identifying all activities hindering the rate of productivity of Bokar with GVSM, obtaining seven green waste generators. The seven green waste generators were implemented for computing economic and environmental indicators to measure productivity (Darmawan, Martini and Rahmanto, 2014). Green productivity computation was carried out by means of developed measurements.

The GPI represents the company's capability within the production environment to manufacture products that are friendly. Post-computing GPI, the other stage is to determine consumer needs for analysing Bokar which will be later checked with Indonesian National Bokar Quality Standards.

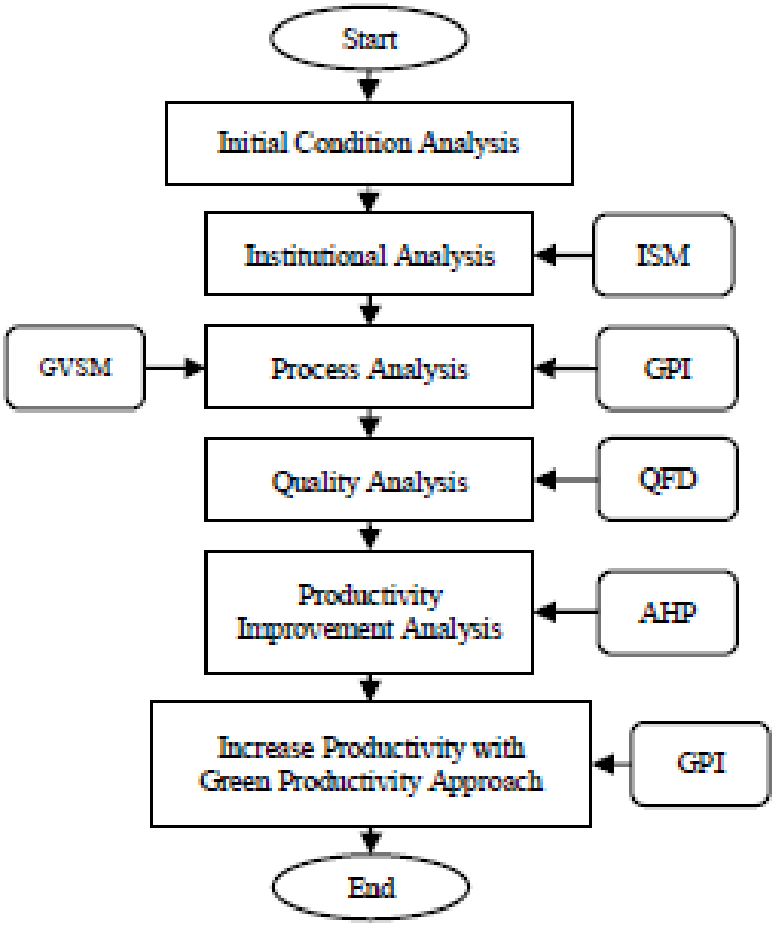

Figure 11. Green Productivity Improvement Model by (Darmawan, Martini and Rahmanto 2014, 136)

This model contains a number of helpful factors that must be taken into consideration. The factors are shown in Figure 12.

Figure 12. Generated factors from Green Productivity Improvement Model (table developed by the researcher)

Governance	Information Technology	Social and Cultural	Green Management
Legal	**Monitor**	**Cultural** **Acceptance**	**Economic** **Environmental** **E-waste**

2.3.12Enterprise Green IT Strategy model

The Green IT strategic reach goes well beyond its immediate advantages. IT is mostly

associated with producing carbon emissions which have a negative impact on the environment in the course of any product lifetime, which includes its use (Unhelkar, 2012). When looking at IT as a source of carbon emissions, instant benefits can be seen from cutting down usage. The basic approach to reducing carbon is to switch off monitors and computers when idle to decrease network traffic.

A complex approach is when IT becomes a strategic carbon enabler that reduces emissions, as depicted in Figure 13 (Unhelkar, 2012). Here, IT processes are used to cut down the emissions produced by IT systems and that of the whole organisation. Finally, the Green Enterprise that was displayed in the layers in Figure 14 depicts Green IT methods that comprise people, organisational infrastructure, law, policies, metrics and standards and other related processes. Finally, several organisations can collaborate with one another, transcending their boundaries to form the industry. However this, together with nationally-based strategies is a relevant discussion but beyond the scope of this work (Unhelkar, 2012).

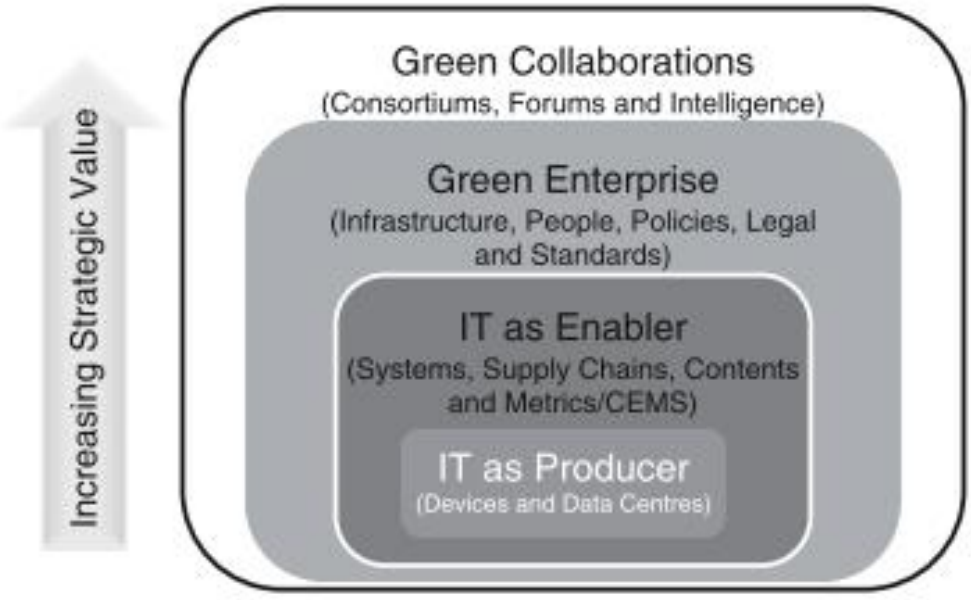

Figure 13. Enterprise Green IT Strategy model by (Unhelkar 2012, 150)

The greatest advantage of a green business method like this is that it will offer a better foundation for sustaining the organisation instead of focusing on just IT. Therefore, business optimisation procedures like Six Sigma or Lean become relevant to an organization's greening. Eliminating unwanted activities inside business processes reduces carbon and improves business efficiency. Therefore, the green business method combines redefining and extending current business methods and formulating new strategies which have special

environmental focus.

The size, type and business location all affect the way Green IT strategies are formulated and should be observed by a discussion of dimensions necessary to change an organisation. The four dimensions are technology, economy, people and process that offer the basis for developing a project plan, roadmap, or developing a green IT method. Thus, a complex green IT method has underlying philosophy, drivers and motivators for businesses undertaking these methods, special steps to create such strategies, dimensions with which such methods can easily be executed as well as important measurement and metrics.

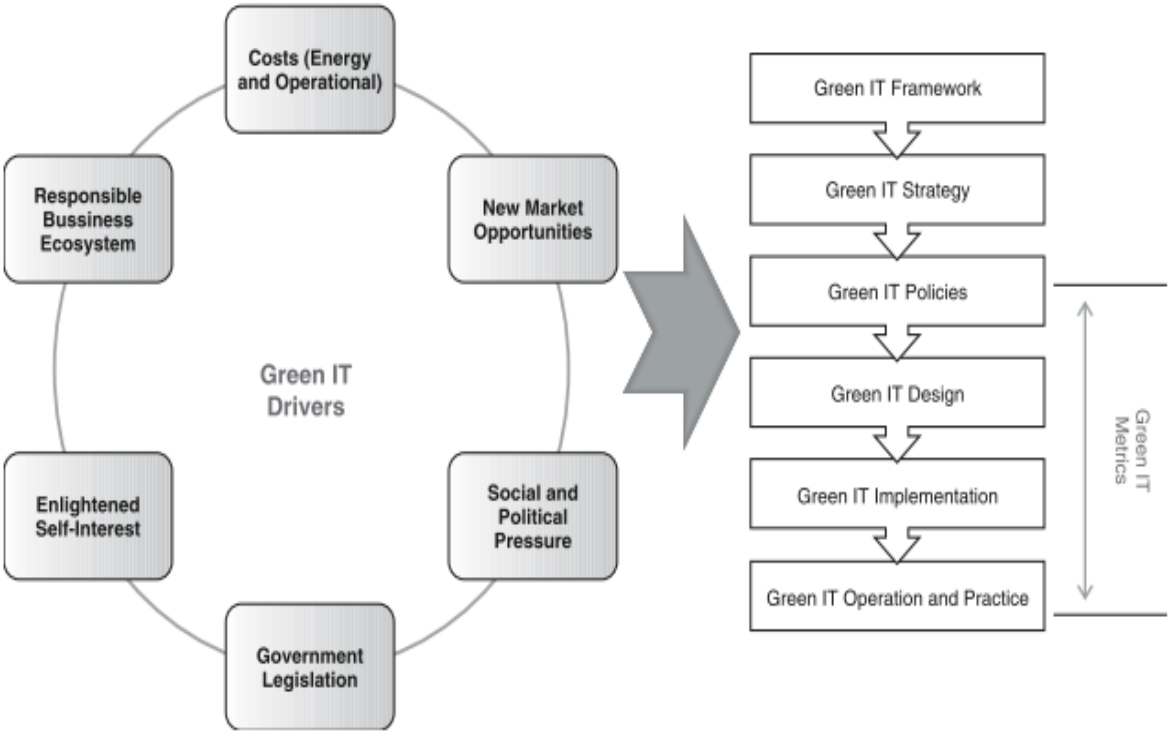

Figure 14. Business driver for Green IT by (Unhelkar 2012, 154)

This model has a number of useful factors that need to be considered. These factors are shown in Table 12.

Table 12. Generated factors from Enterprise Green IT Strategy model (table developed by the researcher)

Governance	Information Technology	Social and Cultural	Green Management
Policies Legal	Smart-Tech Architecture Hardware	Social CSR	Economic Environmental

2.3.13 Internet as Information, a Communication, a Distribution or a Transaction (ICDT model)

As shown in Figure 15, ICDT stands for the process of identifying current business possibilities, which are created in four virtual web areas: a virtual information space, a virtual communication space, a virtual distribution space and a virtual transaction space. (Angehrn, 1997). This differentiation stresses that the Internet has today expanded the periodic market room (i.e., its location with the related model of communication where financial components participate in company activities) by providing fresh places where economists can interact through the exchange of significant information, communication, distribution of multiple services and products and the activation of ordinary businesses (Burgess, Sellitto and Karanasios, 2012).

The Virtual Information Space

A virtual information space comprises new internet-focused routes through which economic stakeholders can show information about who they are, as well as the services and products they offer. Functioning similar to a big billboard that can be accessed globally, flexible and at a less expensive price, the Web has created new marketing avenues for all economic agents, from well-known companies that have catalogues display their services and products to individuals who seek business partners or employees.

The Virtual Communication Space

A virtual communication space extends to traditional areas where economic leaders meet to share knowledge and ideas, influence views, engage in lobbying, negotiate possible collaborations, become part of relationships, and generate multiple types of communities. The resulting rise in the worldwide interaction among stakeholders remains uncertain but possibly significant for service suppliers and products, mostly because communications operations in this latest virtual communication society are instrumental in influencing the trends in sectors of the market.

The Virtual Distribution Space

The Virtual Distribution Space (VDS) is the latest alternative distribution strategy suitable for various services and goods. The first product category that can be effectively spread over a global network connectivity includes products which can be digitized and transferred via a computer network. This category comprises articles, electronic books, images, digital videos, and music tracks along with all software and electronic types of information, from video games to DBMS) (database management system).

The Virtual Transaction Space

The virtual transaction space includes the latest Internet-driven solutions where economic stakeholders can perform periodic company operations such as invoices, orders and payments. In the initial development phase, the Internet was not widely used as a performance space, mainly because of its underdeveloped reliability, security and legal frameworks. The process of defining sophisticated technical alternatives and industry norms and the necessary infrastructure development of transaction handling facilities, in particular for e-payments, is necessary to ensure that businesses operate on a much wider scale in the latest virtual transaction areas.

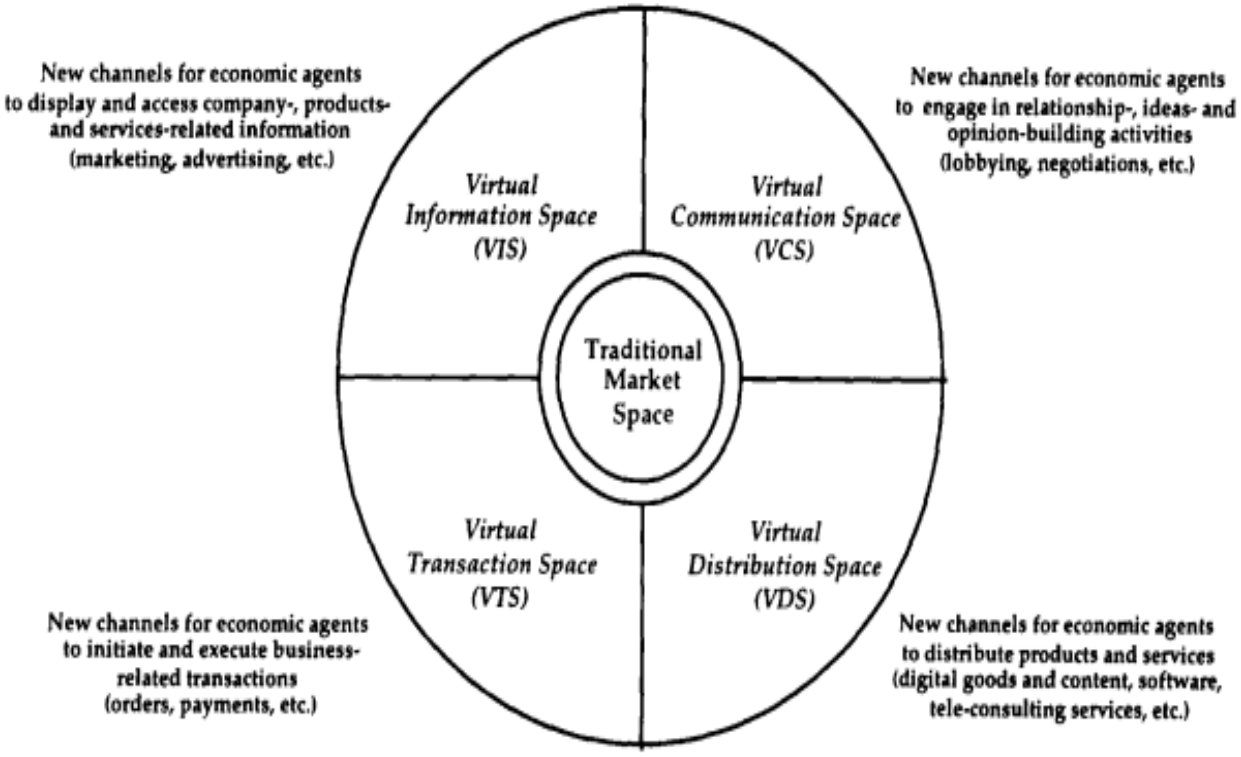

Figure 15. The four virtual space by (Angehrn 1997, 362)

This model contains three helpful factors that must be taken into consideration. The factors are shown in Table 13.

Table 13. Generated factors from ICDL Model, the table developed by the researcher

Governance	Information Technology	Social and Cultural	Green Management
Legal	**Software**	**No factors found**	**Economic**

2.3.14 Metrics based energy efficiency model by Uddin & Rahman

A reliable metric will be anything that can measure sustainability, efficiency as well as cost or executing a green initiative. The biggest challenge that is faced by most metrics when computing the efficiency of energy is the lack of a standard system for grouping various data centre resources. Uddin and Rahman (2012) noted various hardware components that must be tested for energy efficiency and established a relationship between the hardware components, creating a connection between them. The first thing needed for constructing the model is to understand the parts that can be used, based on their measuring workloads and effectiveness, in various categories.

The model as shown in Figure 16 splits data centres into four major areas so that they can be measured separately. The areas are: system performance, energy consumption, facility usage space, and carbon dioxide emissions. All these elements are contained in the service layer. After that, the services platform, which contains parts from the top-layer elements, will develop a specific component layer. Each of these elements has a metrics set that deals specifically with that every component.

This particular model is highly useful for communicating energy efficiency management outside an IT-based organisation. The types of metrics employed within the green boxes are those that will be communicated to all the corporate ranks continuously.

The model employs the following stages to the group data centre in units that are measurable. These phases include:

1. Inventory Procedure (identify and rank DC equipment based on some criteria)

2. Group workloads

A. Inventory Process

The inventory procedure finds and groups all the data centres' components and groups them according to their various parameters such as carbon emission, energy use, equipment type, utility ratio, lifetime, etc.

B. Categorise Workloads

The inventory process has categorised workloads based on their resource requirements and usage. Servers are the core components that perform the bulk of the processing. Hence, they ought to be grouped based on the type of services they offer, and resources needed to process particular requests.

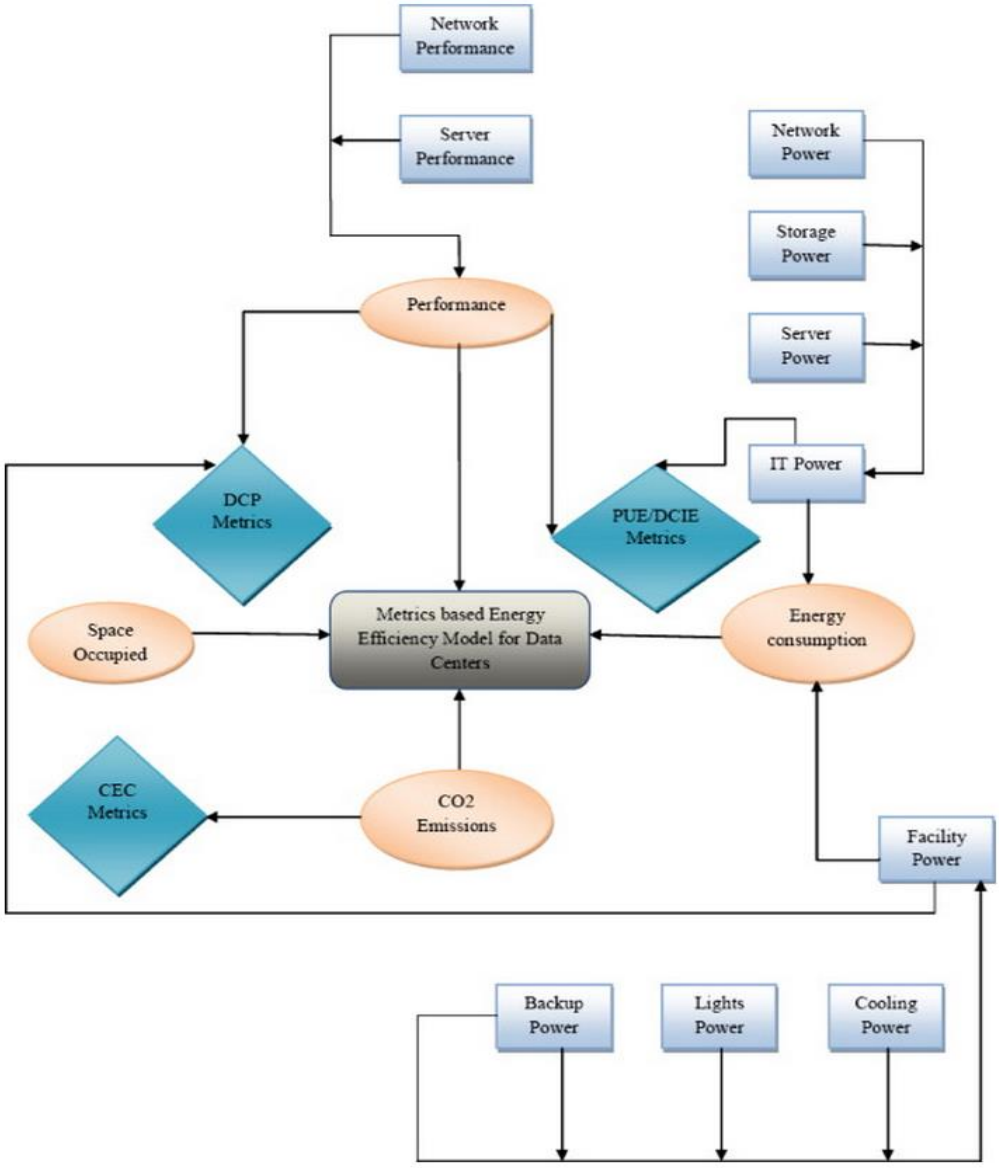

Figure 16. Metrics based energy efficiency model (Uddin and Rahman 2012, 4088)

This model has a number of useful factors that need to be considered. These factors are shown in Table 14.

Table 14. Generated factors from metrics-based energy efficiency model (table developed by the researcher)

Governance	Information Technology	Social and Cultural	Green Management
No factors found	**Smart-Tech** **Hardware** **Software** **Support** **Monitor** **Metrics**	**No factors found**	**Economic** **Environmental**

Behaviour and measuring using of IT model

This model is designed by Schaper and Pervan (2007) for behaviours of technological adoption, and is a suitable action plan to improve the success of information systems. The model focuses on the advanced communication of the technical, social and organisational areas of information systems design, acceptance, implementation and evolution as shown in Figure 17. The model shows the relevance of systems and socio-technical issues experienced by experts regarding ICT acceptance.

The theoretical essence of this particular model employs a properly constructed research model, possibly having the most significant sample size tested so far, for extending technology acceptance study onto the health industry. The outcome of this study has theoretical and practical applications for the five core stakeholder groups: researchers and professionals in health information and informatics systems, tertiary educators, occupational therapy profession, and the commonwealth as well as state governments.

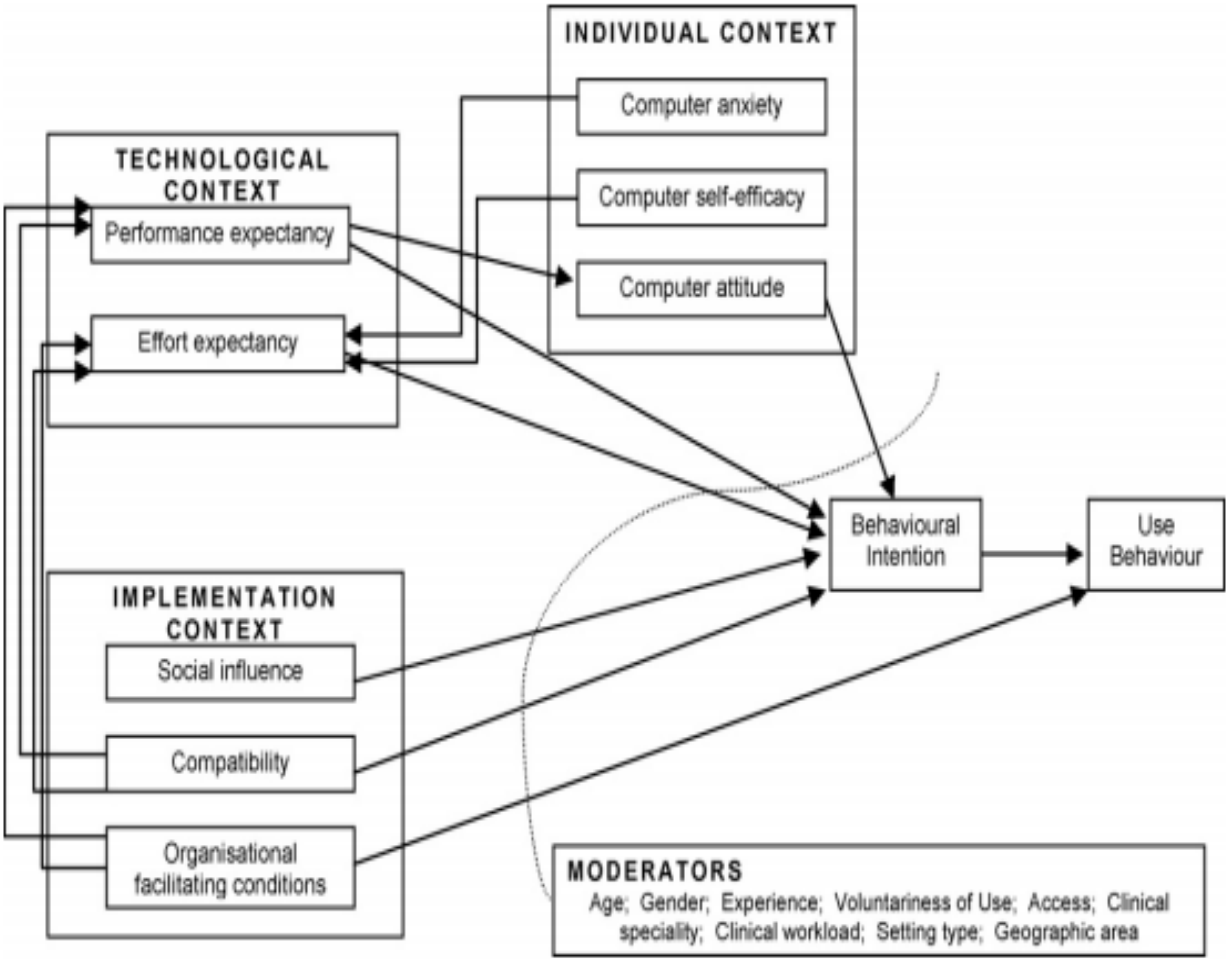

Figure 17. Behaviour and measuring using of IT model by (Schaper and Pervan 2007, 214)

This research has chosen five factors that will be examined for this study's improved model. These factors are shown in Table 15.

Table 15. Generated factors from Behaviour and measuring using of IT model (table developed by the researcher)

Governance	Information Technology	Social and Cultural	Green Management
No factors found	**Smart-Tech** **Software**	**Social** **Cultural** **Ethics**	**No factors found**

2.3.15Sustainability of Green IT initiatives model

Green IT sustainability initiatives model is the power to keep the business starting gain

concerning how the environment performs via Green IT initiatives as shown in Figure 18.The model developed by Nanath and Pillai (2012) has been widely accepted, especially by practitioners. Assessing sustainable performance is a relevant component of green IT initiatives. With the evaluation of Green IT functions emerging as a significant topic within IS research, it needs methods for evaluating sustainable performance. This model reacts to the requirement by producing a longitudinal view in terms of the assessment of Green IT programs. This view will offer a more valuable insight into sustainability when it is compared to independent indicators.

The Green IT program information needed to produce a longitudinal view should be gathered from the case studies that were published in the computer world. The first step undertaken in this the model is separating the firms into “Sustainers” and “Non-Sustainers” depending on the way they have performed environmentally pre/post-Green IT initiative implementation.

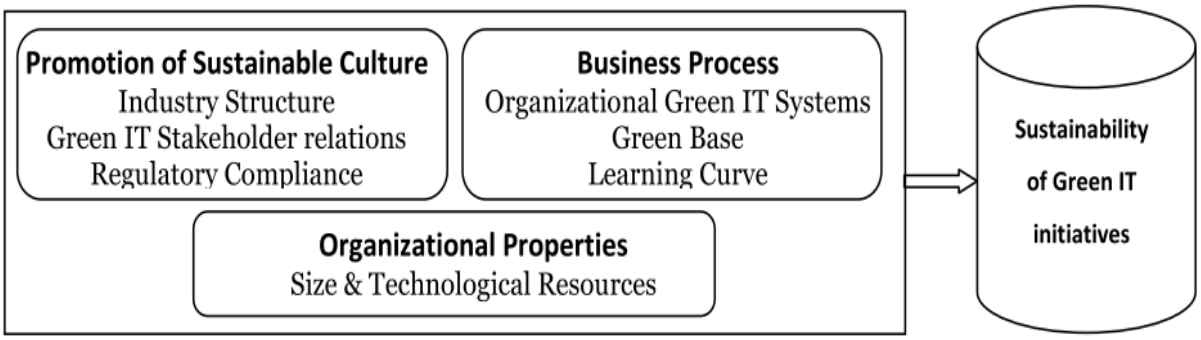

Figure 18. Sustainability of Green IT initiatives model by (Nanath and Pillai 2012, 4)

Promoting Sustainable Culture - The First Dimension

The most reliable green initiative solutions are not found by discovering features along with immediate answers for reducing environmental impact. Rather, they are found by working on the processor value systems within an organisation, leading to a “Green Organization Culture”.

Business process- The second dimension

The group of factors actually handle the variables which align the objectives of available Green IT programs with an organisation’ business process. The model displays all the green initiatives, and how they integrate with an organisation’ business process plays a significant role in continuing such initiatives. This idea has become important from the perspective of economic as well as value systems. The environmental strategy can be summed up as prevention and control.

The organisational properties-the third dimension

This parameter set relates to variables that are unique to an organisation. This model has

proven that organisational factors such as technical resource and size play a crucial role in indicating the sustainability of any initiative in an organisation. Because Green IT demands a starting investment (although the investment may be different based on the implementation level of Green IT), it is extremely significant to consider factors that represent an organisation's characteristics.

In this research, five factors have been selected for examination in the initial model. These factors are shown in Table 16.

Table 16. Generated factors from sustainability of Green IT initiatives model (table developed by the researcher)

Governance	Information Technology	Social and Cultural	Green Management
Policies **Legal**	**Architecture**	**Cultural** **Acceptance**	**Economic** **Environmental** **E-waste**

2.3.16 Stakeholder Perspective model

As illustrated in Figure 19, the objective of this model is to consider stakeholder relations, green innovation and performance (Weng, Chen and Chen, 2015). This green technology framework has been created with six key structures: internal stakeholders, external stakeholders, environmental performance, green innovation habits, firm performance, as well as orientation towards innovation as shown in Figure 20 (Weng, Chen and Chen, 2015).

Figure 19. Conceptional framework by(Weng, Chen and Chen 2015, 4999)

This model is used to identify green innovation practices and gain insight into the effects on stakeholder of adopting the culture of green innovation along with its environmental impacts and company performance. Furthermore, the model considered that all stakeholders place pressure on businesses to improve environmental practices.

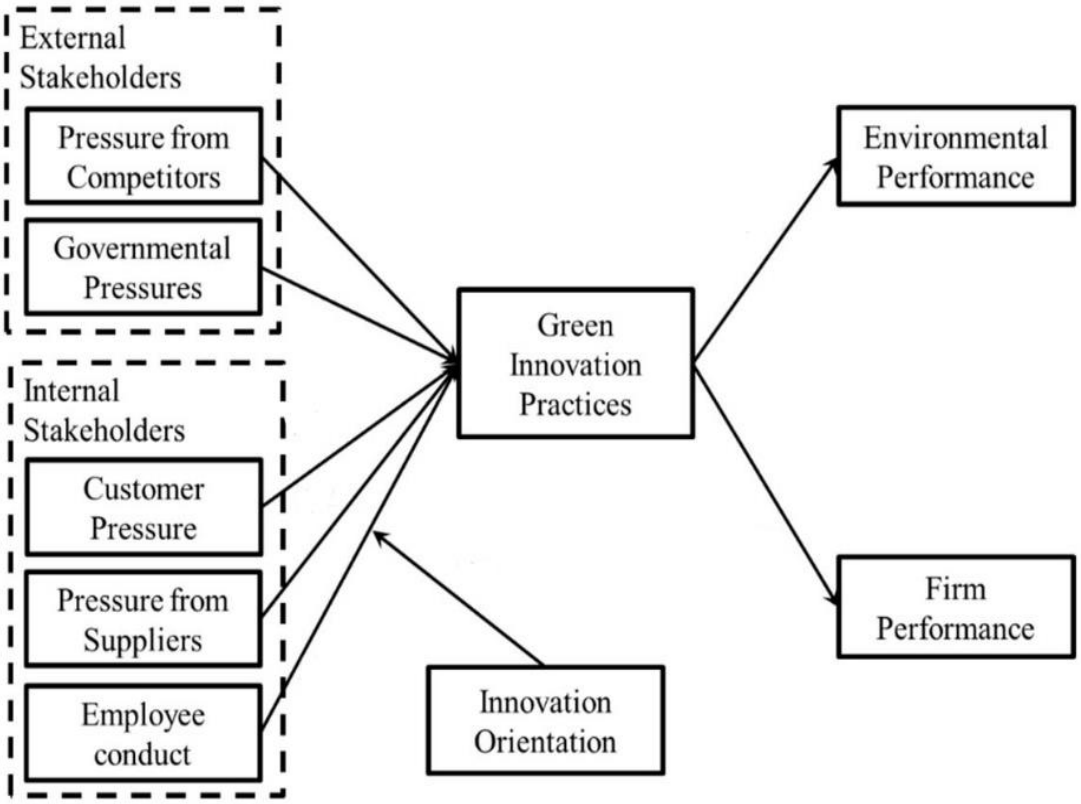

Figure 20. Theoretical Green framework innovation model by (Weng, Chen and Chen 2015, 5000)

External and Internal Stakeholders

The model observed Freeman' stakeholder model and included governments and competitors as foreign stakeholders and customers, suppliers, as well as employees as internal stakeholders (Freeman *et al.*, 2010). In addition, the model viewed all stakeholders as factors putting pressure on companies and urging them to improve environmental practices.

Performance

Two performance types will be talked about in this study: firm performance and environmental performances. Environmental performance is the resulting environmental impact on the surroundings caused by the activities of a company (Claver *et al.*, 2007). The firm performance incorporates different factors including financial performance, business unit performance, as well as organisational performance (Qinghua, 2010).

Environmental Performance

This performance is evaluated in terms of recyclable materials, reduction of pollution emission as well as waste disposal, energy efficiency improvements, and reduction of environmentally dangerous substances. Concerning long-term environmentally focused impacts, an

organization's regulatory measures, which includes pollution prevention and reduction of waste, are better than pipeline-end solutions.

Firm Performance

The performance of a firm can be ascertained, both non-financially and financially. Concerning financial performance, organisations can take care of reduction of government operation costs by merely stepping up resource productivity via green innovation ideas. Additionally, companies can expand into new markets as well as increase market goals through the implementation of environmental practices. Being a long-term functional objective, enhanced non-financial performance can be showcased by better customer loyalty, new patrons or customers, and a better image of a firm.

Innovation orientation

This represents strategic orientation types that obstruct organisational innovation habits and offers a guide for developing strategy and implementation for enhancing an organisation' innovativeness. It explains how to open an organisation up to current ideas, skills, technologies, administrative systems and resources as well as a knowledge system which integrates a learning style, strategic direction, and cross-functional acclimation inside an organisation for promoting innovation.

This research has chosen six factors that will be included in the model. These factors are shown in Table 17.

Table 17. Generated factors from Stakeholder Perspective model (table developed by the researcher)

Governance	Information Technology	Social and Cultural	Green Management
Policies **Legal**	**Smart-Tech**	**Acceptance**	**Economic** **Environmental**

2.3.17 GreenCloud model

GreenCloud, developed by (Liu *et al.*, 2009), is an IDC framework that is focused on reducing data centre power usage while simultaneously guaranteeing improved performance from the user perspective, leveraging the migration technologies of live machines. To confirm the efficiency and effectiveness of this model's strategy, the model represents a comprehensive system that tracks all factors within the data centre, and schedules workload migration to cut down on unrequired power consumption inside the IDC. This model is presented as an online gaming service called Tremulous Error.

For cloud process platforms, both application performance and power consumption are important factors. This architecture offers an effective strategy for reducing power consumption in servers without compromising the expected performance of VM technologies.

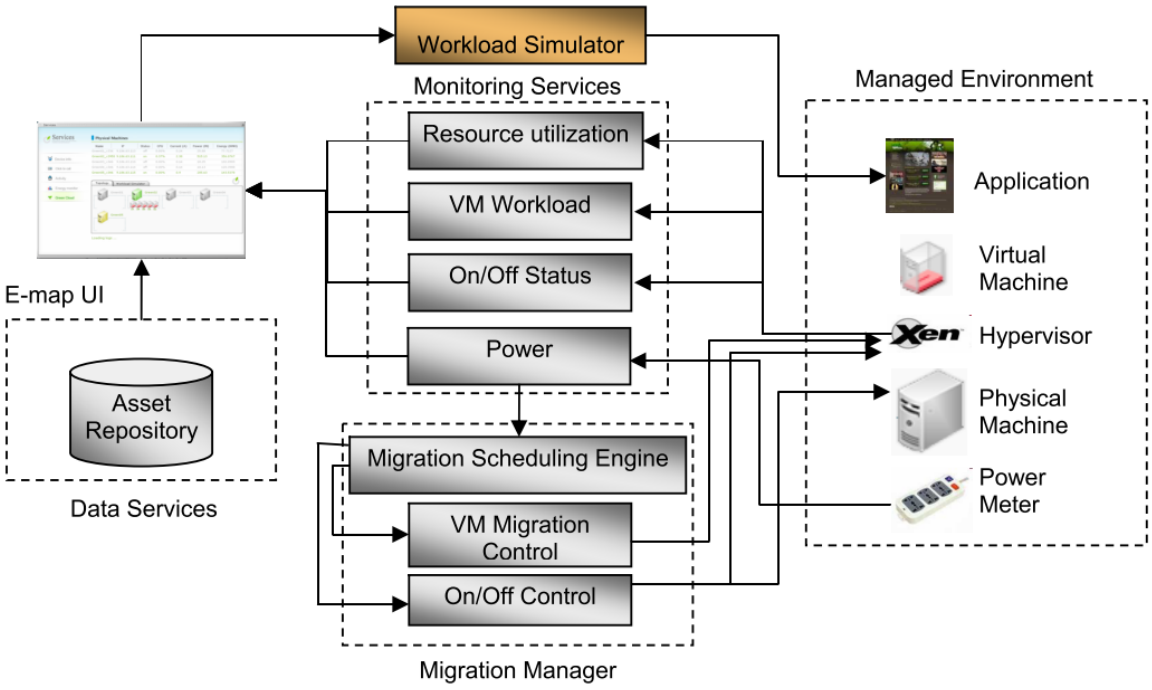

Figure 21. GreenCloud Architecture developed by (Liu *et al.* 2009, 32)

GreenCloud Architecture levels as shown in Figure 21

Monitoring Service tracks and gathers information such as application workload, power consumption and resource utilisation.

Migration Manager activates live migration along with decision-making based on the placing of virtual machines on top of physical servers due to information offered by the particular monitoring service. This migration scheduling powerhouse searches the highest placement using a certain heuristic algorithm, providing instructions for executing the virtual machine migration and before turning the server off or on.

Managed Environment comprise resources, virtual machines, devices, physical machines, remote commands specified for VMs, as well as application with the adaptable workload.

E-Map is a Web-based service that has a Flash UI. It uses a UI for showing real-time views of past and present systems' off/on status, workload status, resource consumption, temperature, as well as energy usage within the system at different scales ranging from high-level background down to personal IT devices (e.g. storage devices and servers) as well as other equipment (for instance, water cooling or air-cooling systems). The E-map can be linked with the Workload Simulator, predicting consequences upon the adoption of a given action by Migration Monitor via real environment simulation.

Workload Simulator applies user instructions for adapting workloads for servers, CPU utilisation, and enables Migration Manager control of different workloads. The E-Map takes the respective real-time values and demonstrates the system performance to users.

Asset Repository can be defined as a database warehouse for storing static server information like IP addresses, CPU configuration, type, memory setting and server topology.

This research has picked a number of factors from this model that will be examined. These factors are shown in Table 18.

Table 18. Generated factors from GreenCloud Model (table developed by the researcher)

Governance	Information Technology	Social and Cultural	Green Management
No factors found	**Smart-Tech** **Architecture** **Hardware** **Software** **Monitor** **Metrics**	**Social** **Cultural** **Acceptance** **Ethics** **CSR**	**Environmental**

2.4 Green IT in GCC

This section aims to discover the current Green IT issues and opportunities for GCC's organisations.

2.4.1 The Current IT problems and challenges in GCC

In the GCC, the main challenges are the provision of data, the strengthening of statistical capacity to collect and disseminate statistics on sustainable development goals, and more effective coordination between governmental and non-governmental institutions (El Sady and El Sady, 2012; Abdelraouf, 2015). The goal is to ensure synergy and non-duplication, building on existing institutional frameworks without developing new structural sustainable development at the local level. The GCC is committed to pursuing the global development agenda through close cooperation between the parties concerned (Sultan, 2012). Activities related to the goals of sustainable development are aligned with the implementation of GCC visions.

Therefore, IT in GCC countries needs to be more sustainable in the future as, currently, most organisations do not have plans for sustainability. The first step to successful implementation is to obtain accurate information about all factors that have been discovered from previous literature. Also, primary data can be collected through interviews and surveys, for example; secondary data can be obtained from data banks previously stored in researchers' institutes. However, due to the lack of data about the GCC, the best way to conduct research on sustainability is to obtain primary data.

Two major barriers to adopting Green IT are lack of clear information concerning business value, and inadequate Green IT leadership (Bose and Luo, 2012; Wabwoba *et al.*, 2013). The lack of IT energy chargeback is also noted as a deterrent, as this may replace the role played by the IT reduction in energy by IT organisations in the GCC (Dedrick, 2010; Ahmad and Babar, 2013). Inadequate understanding, and poor knowledge and Green IT awareness is also another issue (Chou, 2013). Additional Green IT guidelines have become necessary so that businesses can maximise IT for sustainable reasons (Ardito and Morisio, 2014).

However, IT researchers are being criticised for being extremely slow in dealing with environmental sustainability issues (Watson, Boudreau, and Chen 2010). Also, key priority areas include improving the quality and coverage of sustainable development goals in the GCC that require indicators and data analysis and continuing to align government programs and strategies with sustainable development goals, targets and indicators, developing strategies to enhance cooperation and synergies between different actors and actors. The infrastructure needs to be strengthened in order for the sustainable development goals of the

GCC to be achieved. Support is required for the monitoring and evaluation of the progress towards sustainable development goals at national and international levels. International partnerships need to be established so that, through mutual assistance, sustainable development goals can be achieved, especially at the regional level.

The most critical element is to take into account the realities and priorities of the national context (Molla, Abareshi and Cooper, 2014). Building on the national context in setting priorities for sustainable development makes it possible to prepare, implement and ensure sustainability for long-term results (Olson, 2008). In addition, the GCC needs long-term visibility and policy coherence that are essential in order to build on existing plans, frameworks and initiatives aimed at achieving sustainable development goals and early cooperation with new policies and initiatives through mechanisms that ensure alignment with sustainable development objectives.

A major research challenge is to prevent Green IT Research in GCC from being applied due to inadequate communication and cooperation between organizations and IT. This is given the literature's acknowledgement that the effective contact between IT and business managers is essential for optimum IT use in business and the essence of good Green IT is shared understandings among top managers. While the Green IT framework defines various structures, processes and relationship mechanisms, the task remains to determine the best balance of processes to ensure sustainable communication.

2.4.2 Green IT for IT departments in the GCC

GCC nations are regarded as developing nations responsible for high levels of environmental harm. “Regional GCC energy consumption has risen by nearly six times since the 1980s – faster than in any other part of the world” (El-katiri and Husain, 2014, 1). Most of the GCC countries are ranked among the top ten emitters per capita of greenhouse gases (Meltzer, Hultman and Langley, 2014). GCC countries, however, have begun making important investments to move towards green, particularly in Renewable Energy (RE). For instance, Saudi Arabia invested in RE research in other GCC countries by pursuing significant cooperative programmes with countries including the USA and Germany (Ramli & Twaha. 2015). Moreover, GCC countries are transforming their energy sector and market worldwide that promises economic efficiency and technological development (Ahmad and Babar, 2013).

A focus on GCC countries will therefore assist them to improve business quality and to minimize environmental harm. In addition, the GCC countries have integrated research

centres to consider this contribution in the future (GRC Annual-Report, 2014). Saudi Arabia is planning to construct 10,000 square meters of the biggest green IT park, costing cost 20 billion Saudi Riyals (5.3 billion US Dollar) (Fareed, 2012). Study results show that 7.3% of production, 6.9% building, 6.6% IT / ITES, 5.2% educational, and 4.5% of healthcare participants indicated that Green IT initiatives have already been implemented and Green IT artefacts procured throughout their acquisition phase (Khan, Khan and Ravinath 2014, 19). Moreover, the early implementation of a Green IT model in the GCC IT departments prevents problems that can develop in a subsequent shift to Green IT.

2.5 GCC's Visions

Each country in the GCC has a different vision that it is keen to achieve in the next years. Most visions are aimed at reducing reliance on petroleum as the primary objective and activating the income-supply diversification plan. For instance, UAE began to reduce its reliance on oil in 1980 which was 79 percent of UAE's total GDP; and In 2014, 69 percent of UAE's GDP came from non-oil sectors and only 31 percent from the oil sector (Townsend, 2016).

- The government is working to establish a legal environment that supports economic growth and boosts investment. Non-oil sectors that have achieved notable growth in recent years include manufacturing, government services, infrastructure and aviation (Townsend, 2016).

2.5.1 Saudi vision 2030

A report published by the United Nation Organisation in 2018 states that the Kingdom of Saudi Arabia's Vision 2030 is in line with the goals of sustainable development. This vision is based on three elements: a dynamic society, a prosperous economy and an ambitious country (UN, 2018). It states that the vision and its twelve operational programs such as the "Transition Program National 2020" is the foundation for promoting incorporation into the domestic planning process of sustainable growth goals (Nurunnabi, 2017).

The "quality of life" program is one of the most prominent vision programs with direct relevance to sustainable development objectives (Alshuwaikhat and Mohammed, 2017). It is mainly intended to make Saudi Arabia a desirable place to live for its citizens and residents alike. The Kingdom is keen to implement the reforms' economic vision to achieve financial balance and reform the support system within the framework of a protection system (Alshuwaikhat and Mohammed, 2017).

The vision has 17 goals in order to achieve the vision by 2030 (UN, 2018). Each goal has its

target; however, the research will focus on the sustainability goals that are relevant to the research objectives as shown Table 19.

Table 19. Saudi vision goals related to the research (UN, 2018)

Goal number	Objective
7	Ensure access to affordable, reliable, sustainable and modern energy for all
9	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
12	Ensure sustainable consumption and production patterns
13	Take urgent action to combat climate change and its impacts
15	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification and halt and reverse land degradation and halt biodiversity loss

Goal number 7 "Ensure access to affordable, reliable, sustainable and modern energy for all"

- Increase the contribution of renewable energy sources to the energy mix.
- The National Renewable Energy Program is designed to encourage local and international companies to participate in the renewable energy sector in the Kingdom. All projects are 100% financially independent, and the energy to be produced will be based on the independent product model, 25 years for solar-based projects and 20 years for wind-based projects.
- Wind power projects include Saudi Arabia's Aramco's project in "Tarif" 7.2 MW and a 7.2 MW wind power project in "Huraymila".
- The Kingdom currently has 1 megawatt concentrated solar energy project in Tabuk, 2 MW solar panels at King Abdullah University of Science and Technology and 5 MW solar panels at the King Abdullah Center for Petroleum Research and Research.
- The Kingdom has identified the production of 45.3 GW of renewable energy by 2020 to increase its share to the equivalent of 4% of the total energy produced in the Kingdom. The Kingdom's Vision 2030 aims to produce 5.9 gigawatts of renewable energy by 2023, equivalent to 10% of the total energy produced in Saudi Arabia.

Goal number 9 "Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation"

The transformation to the digital economy and the provision of electronic platforms for government entities are among the main priorities of the Kingdom's Vision 2030. This is shown in the creation of the Digital Transformation Unit to accelerate the transition to the digital economy in order to improve the quality of services. The unit aims to achieve the vision of the Kingdom, a leader in a diversified economy through engagement with various government and private entities by implementing enabling policies across sectors and establishing platforms and vital infrastructure. It should be noted that the prevalence of mobile networks in populated areas has remained constant at 99% over the past three years.

Future Saudi Cities Program

The Future Cities Program is a program of technical cooperation between the Ministry of Municipal and Rural Affairs and UN-HABITAT. The program seeks to develop a new vision and strategic planning framework in Saudi Arabia for a sustainable urban future. The main objective of the project is to provide stable, secure, economically inclusive and environmentally sustainable cities with sufficient housing, adequate services and high quality of life (UN, 2018). The sustainable urbanization plan for the Kingdom includes:

- Prepare a detailed strategic plan and implement pilot projects to achieve the sustainable city of Saudi Arabia.
- Analysis of the status of urban legislation and institutional structures in Saudi cities and their ability to implement policies.
- Studying and analysing the current situation in the Saudi cities in terms of their capabilities in providing a sustainable urban environment.

Goal number 12 "Ensure sustainable consumption and production patterns"

Saudi Arabia recently experienced a boom in its industrial and agricultural sectors, rapid urban development, an increase in population growth and an increase in the number of new and future cities. These increases will create many challenges at different levels, especially in the management of various types of waste. The process of waste management, recycling and use, energy recovery and circular economy are important elements for conserving the kingdom's natural resources, creating jobs and reducing greenhouse gas emissions from landfills and converting them into energy. The Kingdom of Saudi Arabia Vision 2030 contains four strategic objectives that support and are closely linked to the goal number 12 to sustainable development:

- Reduce various types of pollutions as air, voice, water and dust pollution.
- Protect and create natural areas such as beaches, islands and natural reserves.
- Improving urban scene in Saudi cities.

- Protect the environment from natural hazards such as desertification.

Goal number 13 “Take urgent action to combat climate change and its impacts”

The actions and plans for goal 13 aim to achieve joint and ambitious benefits in mitigating the effects of climate change and avoiding emissions of up to 130 million tonnes of carbon dioxide equivalent per year by 2030, in accordance with their national priorities and circumstances. These actions and plans are implemented to contribute to economic diversification and adaptation to climate change.

They contribute to economic diversification while achieving the common benefits of mitigating the effects of change climate, by developing the following programs

- Energy efficiency
- Diversification of renewable energy sources
- Techniques for the separation, storage and use of carbon dioxide
- Natural gas exploitation
- Extraction of methane and reduction of gas burning

Goal number 15 “Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification and halt and reverse land degradation and halt biodiversity loss”

Climate change is a major challenge to development efforts, as it leads to increased desertification and decrease widespread rainfall, and climate change increases temperatures that adversely affect all environmental rehabilitation efforts. Human activities such as hunting and overfishing also play a role in the degradation of ecosystems. The urbanization and the accompanying soil dust, the work of heavy equipment and the bulldozers have led to land degradation. In addition, the successive generations on these lands has gradually decreased the interest in managing them properly, and climate change plays a major role in this deterioration due to the lack of rain and the higher temperatures.

According to the analysis of the strategic objectives of the Vision 2030, goal number 15 has the strategic objectives as shown below:

- Reduce all types of pollution
- Protect the environment from natural hazards
- Protection and creation of natural areas

2.5.2 UAE Vision 2021

The vision of the United Arab Emirates 2021 was presented in 2010 by Sheik Mohammed Al Maktoum, the Prime Minister of the UAE and the ruler of Dubai (UAE Vision 2021, no date). Within a wide range of global indicators, the UAE intends to rank among the best nations in the world. To implement this vision, over 300 local and national representatives from 90 governmental and local bodies in 6 National Axes, representing the primary areas to be highlighted in public work over the next few years, created the National Agenda (Stephens, 2011). These six sectors focus on education, health and economy, as well as police and security, housing, as well as government infrastructure and services (Ewen, 2015).

The UAE Vision 2021, with the slogan "united in ambition and determination", contains four basic terms:

First element: “Unite in Responsibility”, based on a cohesive family, social cohesion, moderate Islamic values, and an inherent national heritage. The UAE is dedicated to constructing and fostering the ambition and accountability of Emirati people.

Second element: “United in destiny”, in order to promote the Union in its footsteps, to ensure balanced development throughout the UAE. Effective coordination between federal and local governments and integration of domestic planning and execution in all fields. This feature is accomplished through a powerful union combining a common goal and an integrated and integrated union that protects and balances Emirates in all its spheres, thereby improving the ongoing emergence of the United Arab States as a powerful force.

Third element: “United in knowledge”, to develop a diverse knowledge economy led by qualified Emirate professionals and improved by the finest skills to guarantee UAE’s long-term prosperity. The UAE uses all the potential of the human resources of its citizens by maximizing Emirati involvement and promoting leadership in the government and private industries by identifying and retaining the finest talent.

Fourth element: “United in prosperity”, Emiratis should enjoy a more prosperous, long and healthy life, enjoy a first-class education system, embedded living complemented by excellent public facilities, diverse cultural and social experiences in a clean environment and a natural environment. This component aspires to achieve a high standard of living in a sustainable setting where Emiratis enjoy living.

2.5.3 Kuwait vision 2035

The Kuwaiti government has unveiled its long-term development plan for the next two decades aimed at making Kuwait a global financial and trading hub by 2035 (NewKuwait 2035, no date; Alsayegh, Saker and Alqattan, 2018).

The strategy, which is known as the New Kuwait, has seven main pillars, which also aim to decrease dependence on oil, decrease government spending and role, make the private sector more active and allow Kuwaitis ownership of public-private enterprises. The Kuwaiti government has announced that by 2035 it will generate KD 50 billion (about $180 billion) from the development projects included in the plan (UN, 2019).

The plan is based on collaboration, transparency and engagement to enhance the business environment and the education system to generate the results required for future jobs. It aims to create a sustainable living environment and take advantage of Kuwait's geographic position and foreign relations as an entrance to global trade destinations (Olver-Ellis, 2019). The plan also includes solutions to chronic problems plaguing Kuwait, primarily the housing problem that the government says it has come a long way in resolving in the past four years (Alsayegh, Saker and Alqattan, 2018). UN (2019) states that on their report the development plan is based on seven pillars:

1. Effective government administration through several projects, mainly reviewing and updating the state's structural plan and developing and implementing the national plan for business continuity and disaster management.

2. A diversified economy that contributes to the creation of large-scale construction projects and sustainable energy projects, as well as the establishment of an incubator for small enterprises.

3. Advanced infrastructure implemented through land, sea and air transport projects giant.

4. Sustainable living environment through projects to preserve the environment.

5. High-quality health care through major health projects and the development of health services at international standards.

6. Innovative human capital comes through the establishment of the social safety net and through the integrated system of education reform and the establishment of development centres for young people.

7. A distinguished international position by activating the role of economic diplomacy and enhancing Kuwait's role in the field of human rights and improving the image of the State of Kuwait as one of security and stability.

2.5.4 Oman's 2040 vision

Oman was the first among the Gulf countries to plan ahead its long-term economic vision in 1995 by announcing an economic vision named Oman 2020 (Oman 2040 Vision, no date). In this vision, a number of mega-projects along with the five-year plans initiated in 1976 were introduced. Oman plans to explore future possibilities in order to attain comprehensive growth and satisfy the difficulties of implementing multiple initiatives in the financial and social areas, quality of life and social justice. In addition, it will develop manufacturing industries and diversify the economic manufacturing base and create new sources of revenue and financial resources from oil and gas projects.

However, a new major vision committee was set up in December 2013 (Oman 2040) to prepare new plans for the benefit of both economic and social development, and an assessment of previous plans and economic growth plans for the next stage with the involvement of all segments of the Omani society and the current social situation (Fromson and Simon, 2019). Oman has carried out several significant financial initiatives in the areas of transport, business and tourism through its prior vision, which can be used to realize the remaining projects it plans to introduce over the next 20 years (2020-2040). The Vision's goals (Oman 2040) include identifying the possibilities and optimizing comparative benefits, the most important of which is Oman's significant geographical location and the use of other economies which can help diversify domestic revenue sources, emphasizing the significance of a balanced distribution of growth (Diwakar, 2019).

The objective of Oman 2020 is to attain the many aims of the development process, including "human and social" goals and of the necessity of a vital community in which the citizens live with their Omani identity, their domestic patrimony and the finest components in life and social welfare. The second goal is to construct a diverse economy based on "economy and development". The private sector plays a central role in lifting the economic potential, creating jobs for people, providing Omanis with possibilities of freely-obtainable jobs, decreasing their institutions' enrolment processes and preventing corruption. In many nations around the globe, growth potential is distributed throughout the different Governorates of Oman to attain prosperity and growth. The third objective "governance and institutional performance" is to establish fair organizations that maintain the values of good governance and rule of law, while optimizing the use of accessible funds and enhancing the quality of service delivery and prompt delivery, using the domestic program to foster financial diversification.

2.5.5 Bahrain Vision 2030

The Kingdom of Bahrain has embarked on a long-term plan for the future through Bahrain's 2030 vision, which establishes Bahrain's vision development plans for the future based on justice, competitiveness and achieving the highest level of development compatible with its culture (Bahrain Vision 2030, no date; Al-Azzawi and Hasan, 2019).

Competitive environment

Bahrain offers many incentives to make it a competitive and flourishing economic environment by providing industrial zones with a state-of-the-art infrastructure with the lowest tax rates and operational costs and allowing 100% full foreign ownership. More than 95% of economic activities and sectors do not have local Bahraini partners and have the freedom to repatriate capital, transfer profits abroad. Foreign investments and presence have produced an advanced road system, energy at affordable prices, and the development of key industries. There are also major economic projects that make Bahrain an ideal economic destination; these include Khalifa Port, one of the largest and most advanced ports in the region and the Bahrain Logistics Zone, as well as the Bahrain Investment Marina, the largest private-sector project in the country. One of the world's most prestigious industrial zones is Salman Industrial City with the most advanced infrastructure in the region, and the Bahrain Exhibition City.

In the field of human development, the report of «Human Capital» issued by the World Economic Forum for 2016, stated that Bahrain ranked first in the Gulf, taking full advantage of the economic potential of its citizens. Bahrain was the best performer in the Arab world after having successfully used 85 percent of its total human resource talent, while it ranked 46th globally.

The E-government

In the field of e-government, the United Nations e-Government 2016 reported on Bahrain's improved ranking for the fourth time in a row since 2010. Bahrain ranked first in Arab e-government preparation and is ranked for the second time in a row among the world's most advanced nations. The ranking is achieved by nations receiving over 75% of the overall report indices, which exceed 400 requirements where only 29 of the 193 report nations received the same percentage.

In the field of telecommunications, Bahrain ranked the first in the Arab world and the 11th in the United Nations communications index in 2016, where Bahrain sits in 15th place compared to its previous level in 2014. In the field of electronic books and computerization, all textbooks for primary and secondary school students were converted from the printed version to the electronic version and loaded on the e-learning system.

2.5.6 Qatar National Vision 2030

The Qatar Vision 2030 seeks to transform Qatar into a developed country able to achieve sustainable development and to ensure that its citizens have a good life (Al-Suwaidi, 2018). This vision addresses targeted goals as they provide a general framework for national strategies and more detailed operational plans (Balakrishnan, Harish and M.Z. Al-Kuwari, 2019).

This vision sets out specific features for the future and outlines the five main challenges, as follows: Modernising while maintaining the traditional culture, catering for the current generation's requirements and next generation's needs, addressing uncontrolled progress and focusing on development. Moreover, the foreign workers in the country is progress of the expatriate work, economic and social development and preservation of the environment as well as growth and quality of the objectives.

The National Vision foresees development prospects in four interconnected areas:

Human Development: Developing Qatar's population so that a prosperous society can be established.

Social Development: The development of a fair, secure, well-founded and socially-friendly society, dealing with other cultures and playing a major role in the sustainable development collaboration.

Economic Development: Develop a diverse and competitive economy that will meet and ensure a high standard of living for current and future Qatari residents.

Environmental Development: Environment management to ensure balance and harmony between financial, social and environmental growth.

2.6 RESEARCH GAPS IN EXISTING LITERATURE

Overall, this research has three areas of interest: IT, sustainability, and GCC, as shown in Figure 22. All the research elements must be inside the overlap within this area. Table 20 shows the main research gap.

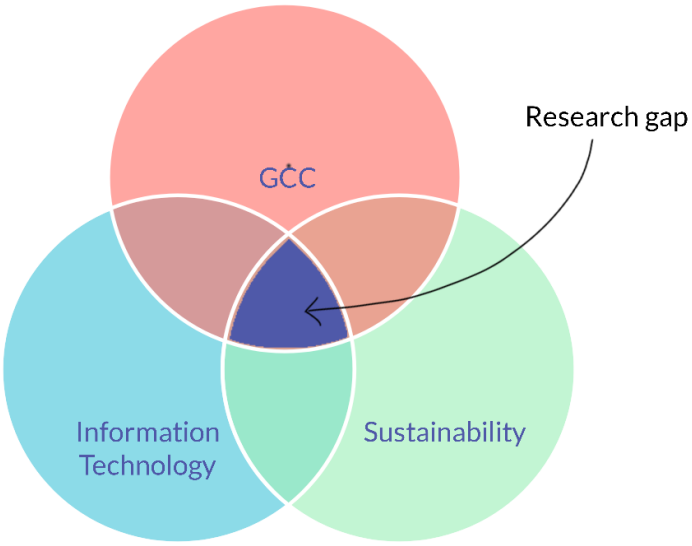

Figure 22. Research gap area

Therefore, several Green IT models have been examined in order to discover and address the research gap. The investigator therefore split the Green IT models into four primary parts for this study: governance, IT, social and cultural impacts and green management; each part has different factors. Governance has political and legal considerations which mainly take into account the GCC rules because each nation has different laws. Information Technology has a Smart-Technology factor, which includes any new technology such as smartphones, computers, and wearables, in addition to architecture, hardware, software, training, support, and practical factors. IT Practice has two factors: monitoring and metrics. Both of these factors are important for calculating and monitoring power consumption.

The Social and Cultural section has five factors: social, cultural, acceptance, ethics, and Corporate Social Responsibility (CSR). The importance of the Social and Cultural section is that it enables the researcher to measure how people in GCC countries will accept the Green IT concepts as well as providing an idea of how people today behave in terms of sustainability. Lastly, the Green Management section has three factors: economic, environmental, and e-waste. The importance of the Green Management section is that it applies economic

organisation effects, such as the return on investments (ROI).

In the next couple of decades, the GCC will become more prevalent in terms of the global manufacturing undertakings as the vision shows, but this will come with a substantial burden imposed on the environment and increased energy consumption (Ramady, 2012), specifically for the GCC as GCC's economy will have to account for a considerable part of this growth. Also, with the rapid development of the economy, GCC companies have encountered increased pressure to protect the environment (Kawach, 2009; Khasharmeh and Desoky, 2013). Many of the firms in the GCC have experienced a 'green barrier' and received ISO14001 certification to meet the environmental needs of their customers from overseas (Haj, 2019; Waxin, Knuteson and Bartholomew, 2019).

To achieve this research goal, the investigator begins by examining certain factors and adding to these as more information is acquired. For example, this research anticipates that the IT department uses very advanced technology in a large telecom company compared to midsize IT departments. The factors in that case are different due to the current needs of the company. Moreover, this research is not limited to investigating current research factors that can be redesigned through data collection and analysis, thereby helping to identify more factors. This study will identify recycling policies and the selection of suppliers. Involvement of customers in the IT strategy plan will help to gather customer feedback, needs and innovations. One of the factors in research is to develop a green policy for this particular business field. "Green IT policy encompasses the frameworks the organization puts in place to apply environmental criteria in IT-related activities" (Molla, Cooper and Pittayachawan, 2011b).

		Governance		Information Technology								Social & Cultural					Green Management		
	Model	Political	Legal	Smart-Tech	Architecture	Hardware	Software	Training	Support	Practice		Social	Cultural	Acceptance	Ethics	CSR	Economic	Environmental	e-waste
										Monitor	Metrics								
1	Teece	✗	✓	✓	✗	✗	✗	✓	✗	✗	✗	✓	✓	✗	✗	✗	✓	✓	✗
2	Ajzen	✗	✗	✗	✗	✗	✗	✓	✗	✗	✗	✓	✓	✗	✗	✗	✗	✓	✗
3	Peter Checkland (Cundill *et al.*, 2011)	✗	✓	✓	✓	✗	✗	✗	✗	✗	✗	✓	✗	✓	✗	✗	✗	✓	✗
4	G-Readiness (Molla, Cooper and Pittayachawan, 2011b)	✓	✓	✓	✓	✗	✗	✗	✓	✗	✓	✗	✗	✓	✗	✓	✗	✓	✗
5	GITAM (Molla, 2008)	✓	✓	✓	✓	✗	✗	✗	✓	✓	✓	✗	✗	✓	✗	✓	✗	✓	✓
6	Green IT value (Chou and Chou, 2012)	✗	✓	✗	✗	✓	✗	✗	✗	✗	✓	✗	✗	✓	✗	✗	✓	✓	✗
7	(MCC's) Green IT Campus Model	✗	✗	✓	✗	✓	✓	✗	✗	✓	✓	✓	✓	✓	✗	✗	✓	✓	✓
8	GreenSoft (Naumann *et al.*, 2011)	✗	✗	✗	✗	✗	✓	✓	✓	✓	✓	✗	✗	✗	✗	✗	✗	✓	✗
9	Enokido et al. (Enokido, Aikebaier and Takizawa, 2010)	✗	✗	✓	✗	✓	✓	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✓	✗
10	Johnson et al. (Johnson *et al.*, 2004)	✗	✗	✓	✓	✓	✗	✓	✗	✓	✗	✗	✗	✓	✗	✗	✓	✓	✓
11	Darmawan et al. (Darmawan,	✗	✓	✗	✗	✗	✗	✗	✗	✓	✗	✗	✓	✓	✗	✗	✓	✓	✓

	Martini and Rahmanto, 2014)																		
12	Unhelkar (Unhelkar, 2012)	✓	✓	✓	✓	✓	✘	✘	✘	✘	✘	✓	✘	✘	✘	✓	✓	✓	✘
13	ICDT (Angehrn, 1997)	✘	✓	✘	✘	✘	✓	✘	✘	✘	✘	✘	✘	✘	✘	✘	✓	✘	✘
14	Uddin & Rahman (Uddin and Rahman, 2012)	✘	✘	✓	✘	✓	✓	✘	✓	✓	✓	✘	✘	✘	✘	✘	✓	✓	✘
15	Schaper & Pervan (Schaper and Pervan, 2007)	✘	✘	✓	✘	✘	✓	✘	✘	✘	✘	✓	✓	✘	✓	✘	✘	✘	✘
16	Nanath &Pillai (Nanath and Pillai, 2012)	✓	✓	✘	✓	✘	✘	✘	✘	✘	✘	✘	✓	✓	✘	✘	✓	✓	✓
17	Stakeholder Perspective (Weng, Chen and Chen, 2015)	✓	✓	✓	✘	✘	✘	✘	✘	✘	✘	✘	✘	✓	✘	✘	✓	✓	✘
18	Green Cloud (Liu *et al.*, 2009)	✘	✘	✓	✓	✓	✓	✘	✘	✓	✓	✘	✘	✘	✘	✘	✘	✓	✘

Table 20. Research gap from comparison of Green IT models

✓ **: Means this element is included in the researcher's model (YES)**

✘**: Means this element is not included in the researcher's model (NO)**

2.7 The proposed framework

The researcher proposed a model to cover all fields of Governance, Social and Cultural, Information Technology and Green Management as shown in Figure 23. The model has a sequence order to begin with “governance” by obtaining company managers' permission to begin applying the Green IT model. After that, manage and discover the “Social and Cultural” impacts to the Green IT implementation. The primary study will then commence with the application of the “Green IT” model for the IT department, covering all elements of IT systems. Finally, the “Green Management” phase is designed to continue implementing the Green IT system and to evaluate post-implementation improvements. This phase is required for the collection of information and potential improvement of the model.

Therefore, the aforementioned factors were found and compared with existing Green models that were appropriate for the requirements of GCC. Each Green model focuses on a single area without giving much consideration to any other factor. Thus, the researcher has divided and analysed all factors based on the PESTEL framework (Political, Economic, Socio-cultural, Technological, Environment and Legal); it is an extension of the original ETPS model (Economic, Technological, Political and Social) (Yüksel, 2012). The investigator later incorporates the model under four sections: governance, social and cultural, IT and Green management.

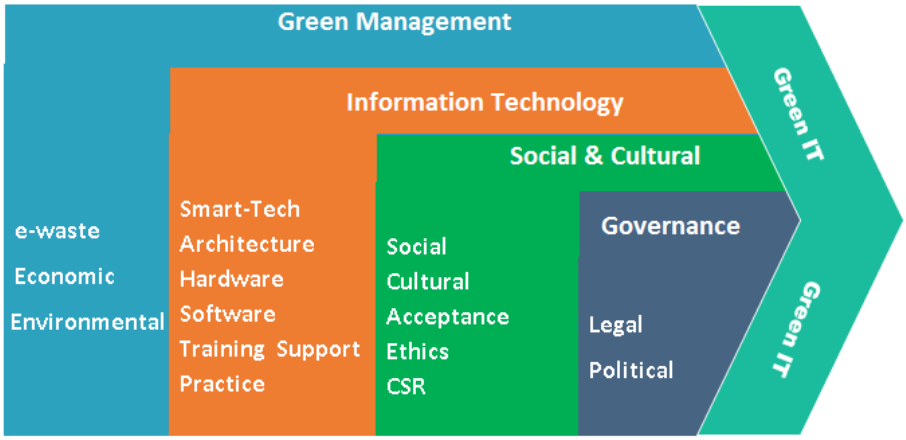

Figure 23. Green IT model for IT Departments in the Gulf Cooperation Council (GCC) organisations (prepared by the researcher)

2.7.1 Governance

Green IT governance assists businesses to structure their Green IT obligations (Schmidt and Kolbe, 2011). There were various Green IT models which take governance into account to organize the duties and power of the executors for effective execution by the government. “Green IT Readiness” is, for example, a green IT model adopted by Molla, Cooper and Pittayachawan (2009) and is split into five key parts: Green IT Attitudes, Policies, Practice, Technology and Governance. G-readiness is the ability of an organization to use environmental requirements to apply its IT technical facilities by combining attitudes, policy, practice, technology and governance (Molla, Cooper and Pittayachawan, 2009). In addition, the “Contingency Model” is a Green IT model developed by Schmidt & Kolbe (2011) focusing on governance. In order to ensure that the company can shift to greener procedures, the model provides clear directions on how to legitimize a fresh Green IT approach. “The flexible Green IT governance model presented allows a company-specific design of Green IT governance” (Schmidt and Kolbe, 2011). Organisations are confronted with greater energy costs, and can also incur further government charges unless they address the environmental consequences of their practices (Murugesan and Gangadharan, 2012). Governance has two main factors that will be discussed in this research: Legal and Policies; each factor is discussed below.

2.7.1.1 Legal

There are many wastes products in the GCC that can be recycled and used again by applying legislation in order to meeting the new requirements and save natural resources. For instance, there is a law stipulating that all people living in Sweden must sort out their waste, and there is a system to take advantage of and recycle materials and energy in the waste (Malmodin and Lunden, 2016). Near most residential buildings, there are stations or garbage rooms where people can sort their waste. That means everyone can throw away food, metal, glass, plastic, and paper products in different containers; in this case, people are complying with the law.

Therefore, in the GCC there are places enabling compliance with Green laws or regulations to get rid of waste, such as:

Recycling Station: Here one can leave cans and packaging, newspapers/newspapers and batteries.

Environmental Station: which is often found in gas stations, here all residents can leave items that are hazardous to the environment.

Recycling Centre: Residents can leave massive waste and larger items as well as hazardous waste such as chemicals and electronic materials.

Therefore, the research examines the legal factor in terms of current regulations in GCC countries and investigates whether waste disposal is conducted via the three means mentioned above.

2.7.1.2 Political

Public sector organizations are very interested in analysing their behaviour in regard to sustainability (Rios-Morales, Ramady and Brennan, 2012). Sustainability data, sustainable development strategies, and policy / legislative impact assessments are included in local public sector accounting in some countries (Molla, Cooper and Pittayachawan, 2009; Waas *et al.*, 2014). In addition, the sustainability impacts of the operations of any government departments or institutions can be revealed at the organizational level. For example, government corporations adopt sustainability principles and governments provide evidence of these activities. In some cases, local government organisations take the lead in publicising sustainability in the public sector. Some of the above examples have shown how public sector organisations at the state level, such as ministries and agencies, have begun to report sustainability.

GCC policies can make essential contributions to sustainability reporting. First, policies can demonstrate best practices by drawing attention to the organisational impact on sustainability (El Sady and El Sady, 2012). For example, sustainability can be incorporated into department policies and annual reporting. Also, the application of these policies could be monitored by an independent body outside the government, that can oversee and evaluate sustainability practices, thereby expanding the role of the GCC policies in providing financial assurance services. Therefore, many sustainability factors such as stakeholder assessment and staff participation have a direct correlation with good governance and transparency. Thus, the main aim is to make sure the new sustainable policies are appropriate for GCC countries' needs.

2.7.2 Social and Cultural

The social and cultural theme is considered as the community affects and is influenced by many other areas of human activity and is an important component of the model. Its importance is reflected in the ability to integrate with other cultures and societies, making the community more open to the rest of the world.

It is known that culture is not acquired genetically and is not a human instinct, but it is the discovery of the human (Baker, Al-Gahtani and Hubona, 2010; Campbell, Ratcliffe and Moore, 2013). Therefore, the culture within this context is the humanity of the features and hopes for any culture without the human presence that creates this culture and develop. Culture is passed from generation to generation through the system of customs and traditions and societal norms. These aspects of culture can change through external interactions, evolving from generation to generation and from society to society.

The GCC exists within a dynamic and strategically open area. The presence of both Arab and foreign nationalities in this area has an impact on the cultural fabric of the Gulf society and the creation of a cultural diversity that has an influence on language, values, customs and traditions (Waas *et al.*, 2014; Romanowski, Alkhateeb and Nasser, 2018). Economic and political, and other aspects of human communication are affected. Therefore, this theme has five factors that influence Green IT and sustainability: Social, Cultural, Acceptance, Ethics and CRS; each factor is discussed below.

2.7.2.1 Social

The social factor is focused on how the GCC will act in terms of making society aware of Green IT and sustainability since few people know about these concepts. The economic growth and diversity all contribute positively to the change in the GCC's internal picture, but the adverse effects of this change have not been ignored. The economic boom that increased GCC wealth did not occur in all the Gulf countries; it was concentrated in countries that responded to this wealth by social construction, which was devised by modern economic values with concepts that were not gradually assimilated (Harrell *et al.*, 2017; Platonova *et al.*, 2018; Romanowski, Alkhateeb and Nasser, 2018). Therefore, Green concept might involve the new social aspects due to the new economic visions.

2.7.2.2 Cultural

The cultural factor investigates whether the Green concepts will be part of GCC society culture as the GCC is living in a dynamic and strategically open area. The presence of many Arab and foreign nationalities in GCC countries has an impact on the cultural fabric of GCC society and the creation of a cultural diversity that has influenced language, values, customs and traditions (Kapiszewski, 2017; Worrall, 2017). Also, the multiculturalism affects the economy and politics, and other aspects of human communication that might include Green concepts to these elements. The coexistence of various human races inevitably affects the culture of any society, and the mixing of cultures contributes to a positive or negative charge depending

on how that culture mixes with the indigenous culture of society, bringing new ideas to the fore.

2.7.2.3 Acceptance

Acceptance is related to investigating how GCC society accepts new concepts that will give the opportunity to implement green IT and sustainability in any organisation (Alsabbagh and Al-Jayyousi, 2018). The change in values must be compatible with those of society and be adjusted or refined and reconciled over time (Curşeu, Schruijer and Fodor, 2017). As education is the key to the renaissance of society and ensuring positive change that increases productivity and reduces unemployment and other negative events, its development should be a top priority, with any repercussions from some segments of society that are not receptive to change or concerned by rapid social change. In the same context, universities are usually the places where developmental changes, including social changes, begin. They also create new programs and specialisations that meet the needs of the future labour market, including the professions.

2.7.2.4 Ethics

Green concepts are one of the main ethics elements as the primary goal is to save the environment. The ethics factor aims to get an overview of the current ethics in regard to changes in the GCC and how green ideas might attract society's attention in GCC countries. The new high technology that offers various technologies such as automated driving and advanced algorithms gives GCC the opportunity to change learning environments and to understand the impact of technologies on environmental issues (Ali, 2015; Sidani, 2015; Nair, Al Marzooqi and Al Khamiri, 2017). If no consideration is given to social ethics, it would be difficult for companies to recycle products, reduce their carbon footprint, and save money. The most valuable and responsive companies today are those that respond correctly to ethics and create a better environment for staff and customers.

2.7.2.5 Corporate social responsibility (CSR)

Three major components of the CSR are the protection of the environment, growth of the economy, and social justice. At the 1992 United Nations Environment and Development conference in Rio de Janeiro, politicians from more than 100 nations adopted Agenda 21, a twenty-first-century plan for sustainable development. The Economic and Social Council's Commission for Sustainable Development tracks the Governments in their nations who have agreed to adopt the plan. Agenda 21 described GCC transnationals as playing a vital role in the social and economic development of States. Therefore, the CSR factor will investigate

how current organisations in GCC countries are responding to this concept as CSR includes Green concepts.

Sustainable economic growth in GCC countries depends on job creation, education, poverty alleviation and good environmental management. Companies have a prominent role to play; they should contribute to the reform of the communities in which they are located. This reform is based on CSR initiatives that are in line with national development goals. In a study of over 28,000 internet participants in 56 nations worldwide, 66% of customers prefer to purchase goods from businesses with social responsibility projects that serve society (Grimes, 2012). In addition, 62% want to do business with those businesses, 59% want to invest in these, and 46% want to purchase goods and services from those businesses with additional funding.

2.7.3 Information Technology

GCC is currently witnessing a quantum leap in the digital transformation of government services (Mahmood, Weerakkody and Chen, 2019). These services aim to facilitate access to e-government and increase gross domestic product and the number of jobs in the long term. The public entities are developing all their services and systems to keep connected with the national digital transformation through their GCC's vision requirements (Saxena and Al-Tamimi, 2018; Alshubiri, 2019). The vision includes a strategic objective for the development of the digital economy.

In partnership with the private sector, public authorities are developing an advanced digital economy that works primarily through digital technologies, supported by innovation and contributing significantly to the development of the GCC economy (Braendle, Farah and Balian, 2017). This objective covers aspects of the development of digital technologies in the industrial and service sectors and their impact on the social sector. The objective also focuses on innovation in digital technologies and the contribution of the digital economy to GDP and employment.

The public sector has adopted a number of programs and initiatives that contribute to the development of the country and the digital economy, including the ministries responsible for Information Technology (AlSharekh, 2016; El-Kholei and Al-Jayyousi, 2018; Gremm *et al.*, 2018; UN, 2018). The most prominent programs and initiatives include the following.

Digital Transformation Unit: The goal is to build a digital society, digital businesses and digital homes. This requires establishing digital platforms to enhance communication and efficient community involvement, so that the GCC's people, expatriates, tourists and investors can enhance their experiences. A digital economy for business development and competitiveness

improvement has a positive impact on the financial position, knowledge generation and improved services of a country. Digital homes can promote innovation by supporting local and international technology and innovative investments and alliances.

Government Transaction Program: aims to improve public sector productivity and effectiveness, provide better facilities for people and entrepreneurship, and facilitate investment returns and deliver highly accurate data on time. Therefore, the information technology theme will consider all previous elements by adopting the technological elements as shown below.

2.7.3.1 Smart Tech

Smart technology includes any technologies that are involve computing by end-users, such as smartphones, tablet, and wearable devices. The adoption of devices has increased significantly with the technology revolution just in the past ten years, and many organisations already have high investments in these technologies. The GCC is no exception, and there are many investments by co-government organisations using phone applications to serve end-users. Therefore, this factor aims to investigate all smart technologies used by the end-users in GCC countries and ensure the best way that they can be used based on sustainability concepts.

2.7.3.2 Architecture

Green computing is becoming increasingly common and its architecture is one of the main features of green computers. Basically, architecture has five different areas: physical, operating platform, sustainable intelligence, application development and the cloud. In GCC, these elements have been partly considered and considered by most of the GCC visions. This research will investigate the current data-centre architect to determine best practice in order to upgrade to be greener.

2.7.3.3 Hardware

In green computing, there are many goals to achieve; one of the goals is to reduce the amount of hardware that runs on one platform. Moreover, employees are encouraged to reduce the amount of printed paper and use the technologies instead. Also, another example of reducing the hardware is using virtual machines under one organisation instead of having a computer running for each client. Furthermore, almost all companies in the GCC use computer technology and there seems to be no clear plan in terms of the use and disposal of hardware.

This factor aims to investigate the current hardware used in organisations and their plans for reducing and recycling.

2.7.3.4 Software

Green software aims to reduce the environmental impact by designing, developing and using software efficiently. Therefore, software is always a critical component of the green platform, although many developers have no a clear standard for this term. For instance, there are many ways to reduce power using efficient programming such as using recursion instead of a loop. In GCC, green software needs to be considered and is a part of this research as the literature shows a minimal consideration of this area. This factor aims to investigate whether software has been developed efficiently and to discover the current software being used by companies.

2.7.3.5 Training

Most organisations have a training program that aims to upgrade the employees' skills as well as increase awareness. Green IT and sustainability are new areas that need to be considered and included in companies' plans. All GCC visions have a distinct plan for sustainable goals that need to be aligned with companies' objectives. Therefore, training is one of the tools that help employees to become aware of going green. The training factor will investigate what the current training plans are of GCC organizations and how they could include Green IT and sustainability in those plans.

2.7.3.6 Support

The support factor aims to investigate how companies train their support IT team to meet the organizations' requirements. Sustainability knowledge needs to be included in the training if the IT team is going to train other employees in green practices. in the GCC, IT teams need to be considered and given the opportunity to train other employees about sustainability. For instance, they could give the employees a session about how to print any paper as a PDF document instead of using physical paper, also how to turn the computer to doze mode when not being used.

2.7.3.7 Practice

Responsible computer use can help to reduce the environmental damage. Therefore, several tools can be applied to reduce the power consumption and increase production efficiency. Practice involves monitoring and metrics as shown below.

2.7.3.7.1 Monitor

Monitoring of devices can help to determine usage of devices in data centres and obtain real-

time data about their power consumption. Monitoring can help data centres to reduce power consumption and install new devices efficiently.

2.7.3.7.2 Metrics

Metrics is a small software that is programmed to reduce the power consumption and increase the efficiency. These metrics need to be installed by users or administrators, or by a third party, or programmed locally.

2.7.4 Green Management

Economic development in its general form aims at providing a solution to the problem of economic underdevelopment over time; thus, it is concerned with the most comprehensive and efficient use of the economic resources available for the purpose of reconstruction and human development in order to improve the quality of human life (Callen *et al.*, 2014; Sweidan and Alwaked, 2016; Garas and ElMassah, 2018). Adequate living standards, as defined in the Human Development Reports of the UN Development Program, is the process of expanding economic, social, political and cultural options (Habitat, 2013). The environmental dimension in the economy has changed the concept of economic development from the mere increase in the exploitation of scarce economic resources to satisfying multiple and renewable human needs by implementing the concept of "sustainable development or sustainability development" (Barkemeyer *et al.*, 2014; Assembly, 2015; Sauvé, Bernard and Sloan, 2016). Sustainable development is defined as: ongoing development that does not prevent the exploitation of economic resources such as water, oil and forests, but prevents the unjust exploitation of these resources to the extent that affects the share of future generations of those resources, especially if resources such as oil are not renewable and subject to depletion. Sustainability can be enforced either in the near future or over a period of time. Therefore, the Green management theme will have three different factors which are economic, environmental and e-waste. These factors need to be applied in order to ensure a sustainable model in the long term.

2.7.4.1 Economy

Green economy ensures that the achievement of social and economic development occurs while preserving the environment with all its components, systems and vital spectrum. In order to achieve "economic sustainability" in GCC countries, the traditional concept of the economy and its applications must be abandoned, or at least the environmental perspective of the economy must be considered. This can be done by adopting the "Ecological Economics"

perspective, and economic systems with activities, systems and environmental considerations within the long-term strategic perspective. This ensures environmental sustainability and stability and ecological balance, and maintains the components and systems and diversity of vital resources. However, this requires addressing the problems of the environment in a serious and in-depth manner and requires that the environment and the economy work together and not in isolation. Environmental economics is based on two pillars: efficiency in the use of the resources, and the achievement of high environmental concepts for future generations.

2.7.4.2 Environment

The environmental factor is to ensure the new GCC model ensures development while simultaneously safeguarding the natural resources. In the GCC, a report indicates that the environmental situation is exposed to serious and growing environmental violations, which have negatively impacted ecosystems such as bodies of water due to the adoption of "environmentally unfair development, including the disposal of industrial waste, and sewage in those areas and fishing". This has led to negative impacts on terrestrial ecosystems, air pollution, desertification, salinity of land and water, and degradation of land fertility. People of the GCC are now moving from rural areas and villages to the big cities, which has exacerbated the environmental problems, and also led to bridging large areas of the sea, all of which have negative effects on the environment and biodiversity.

2.7.4.3 E-waste

The e-waste factor aims to ensure that the new model includes the safe disposal of technological devices in GCC countries. The Gulf Organization for Industrial Consulting (GOIC) Works with the GCC and global businesses to provide GCC manufacturing installations with extensive recycling alternatives including complete recycling services tailored to each sector's requirements (Garas and ElMassah, 2018). GOIC's services include designing, implementing and supporting the best programs for specific industrial requirements, and providing recommendations and inspections of waste management procedures and programs.

GOIC aims to deliver highly efficient and cost-effective recycling programs that meet the needs of different industry sectors and are challenging. In addition to technical support services, GOIC provides knowledge transfer, training and other innovative solutions to achieve the environmental, technical and marketing objectives of Gulf industries.

The three most important challenges faced by the GCC countries are: reducing the environmental burden, creating new job opportunities and enhancing the diversification of income sources in Gulf economies. Recycling investments can significantly contribute to addressing the three challenges and provide meaningful returns to all stakeholders. In this context, there are clear opportunities to support recycling in the GCC, and GOIC considers international models such as the EU program an example. Similar models would help to create an environment-friendly economy. The GOIC is a sample of an industrial consultation that is working in the GCC, which will be considered on this research.

2.8 Chapter summery

This chapter reviews various Green IT models presented in the literature in order to find the research gap in terms of GCC countries. The initial finding is that Green IT and sustainability have various themes that need to be considered when determining suitable factors that match current needs. In order to find suitable pieces of information to cover the literature review, in the beginning, the researcher needs to have an understanding of the current situation in GCC countries. Therefore, the research has four main themes, and each theme has several factors. The first theme was governance, which will focus mainly on legal aspects and policies. These two factors have aspects that need to be investigated in the next chapters. The second theme is social and cultural; this theme has several factors that investigate the current situation for GCC countries. The information technology theme is the main theme for this research, which covers all the technical parts in order to apply green IT models for GCC countries. Therefore, information technology has the greatest number of factors; all these factors will be considered during the next stages. The last theme is green management, which aims to ensure that the green model is implemented in the targeted organisation in the long term.

GCC countries have their own collective culture and society; these shared characteristics have their own benefits and this research will be appropriate for all of them. However, each country has its own system of governance, as some countries are still not technologically advanced. Therefore, this research will make sure that the model fits these countries by studying the common variables. In terms of Green IT and sustainability, GCC countries have taken initiatives to be greener; however, a high standard of green-associated legislation needs to be applied which addresses recycling and paper waste disposal, for instance. The next chapter discusses and justifies the adopted research approach.

CHAPTER 3. RESEARCH APPROCH

3.1 Introduction

The previous chapter introduced the initial model and found the research gap from various models. The research gap in Table 20 compared all the model factors in order to build the initial model that suits GCC countries. The research methods for this study are explored, and the chosen mixed-methods approach has been chosen and justified.

Research in information systems offers valuable research characteristics to lead the possibility of various research approaches (Goldkhul, 2012). These are the basis of most IS research guidelines for data analysis. Saunders, Lewis and Thornhill (2015) introduced the research onion approach to simplify the research structure by dividing the research characteristic into a number of layers to peel off each level. The researcher has selected the research onion as an appropriate guide for this research as shown in Figure 24. In the first section of the chapter, the researcher selected a research design from the research onion. The first step is to choose the philosophy or paradigm of the research, which leads the researcher to see the possible areas of the research.

After that comes the analysis part where the researcher needs to confirm the research strategies and the time horizon. Lastly, the research onion approach requires the researcher to select the best method for the collection and analysis of the data. Therefore, this chapter discusses each onion layer, and which strategy was selected, then justifies the suitability of the selection. In addition, it shows the possibilities for each layer to connect with other strategies in the IS research. This chapter shows how the researcher develops a methodology to achieve the desired results by following the typical research process.

The next sections present the data collection and analysis techniques for this research. Lastly, the details of the ethics approval required for this research are discussed.

3.2 Research Significance

At the beginning of a research project, it is essential to establish the importance of the research problem and the proposed contributions that the study will make, which are expected to be both practical and conceptual. The practical contribution is related to the application pf the findings to practice, and the conceptual contribution is made to the existing body of knowledge. This research is expected to make both the conceptual and practical contributions. The next sub-sections give details about the research contribution.

3.2.1 Theoretical Significance

This research seeks to implement a green IT model enabling GCC countries to be more sustainable and environment-friendly, particularly for IT departments. Also, it investigates what is already known about Green IT and sustainability in GCC countries and to propose concrete improvements to current systems. Therefore, the main aim of this research is to develop a Green IT model that suits GCC countries, and to determine the factors needed for this model. New tools are applied to the Green IT model to reduce environmental damage and to increase Green IT awareness. In order to help GCC countries establish an IT strategy for the implementation of green IT policy in their departments, the Green IT model will also consider all the required factors. In addition, the new model could be included in policies for reducing environmental impacts in the GCC countries. In addition, the research results will support GCC and international scientists and scholars.

3.2.2 Practical Significance

Researchers should consider all Green IT factors such as paperless systems, e-archiving, virtualization, energy control systems, cooler systems and recycling in order to create a new Green strategy as, “currently IT infrastructures contribute about 2% of total CO^2 footprints” (Uddin and Rahman 2012). The principal practical importance of this investigation is to examine the current GCC data centres and to use Green IT factors to determine whether the data centres comply with the Green IT model. For example, the workplace observations technique is used for measuring energy consumption, floor layout, server settings, consolidation of servers, cabling factors and optimisation of power supply (Toby, Anthony and Robert, 2008). Following the determination of all factors and the establishment of the Green IT model, it will be tested to determine whether it is acceptable to consumers. GCC governments, organisations and IT departments are expected to be more sustainable and greener in multiple GCC sectors by implementing the Green IT model.

3.3 Research Aim and Objective

Environmental damage is a global issue which continues to get worse and must be resolved instantly. This research provides an in-depth study of various Green IT models and concludes with a Green IT model suitable for the GCC. It will undertake qualitative as well as quantitative research with various personnel levels to acquire information about respondents’ views, routines, areas needing improvement, and readiness to adopt the new model. Many of the various accessible methods have been applied in order to decrease energy consumption and

paper usage using intelligent techniques. The shortcomings of the alternative methods for ensuring maximum efficiency have been recognized and detailed. Translation guidelines were created to overcome language obstacles and interviews were recorded to safeguard the integrity of interview responses. The research forges a route towards future savings of capital and service quality. Table 21 shows the objectives and questions for this research, which will be discussed in detail in sections 3.3.1, 3.3.2 and 3.3.3.

Table 21. Research study objectives and questions

Objectives	Questions
Main objective: To develop a Green IT model that meets the GCC countries' requirements.	Main Research Question: How can a Green IT Model meet the GCC countries' requirements?
First Sub-Objective: To gather the opinions of various stakeholders in GCC countries concerning the Green IT model?	First Sub Research Question: What are the opinions of various stakeholders in GCC countries' concerning the Green IT model?
Second Sub-Objective: To determine how the Green IT model will be useful for IT departments in GCC countries.	Second Sub Research Question: How can a Green IT model be useful for IT departments in GCC countries?

3.3.1 Main research questions and objective

- Question: How can a Green IT Model meet the GCC countries requirements?
- Objective: To develop a Green IT model that meets the GCC countries requirements

As Table 21 shows, this research has one main question followed by two sub-questions. The main question is to build a Green IT model for GCC countries based on GCC requirements. These initial requirements were discovered by looking at previous Green models and literatures to generate the factors required for the new model. To answer this question, the researcher conducted a comprehensive literature review to discover all current requirements of Green IT and sustainability. Therefore, the use of Green IT and sustainability are agents for reducing current environmental damage and improving sustainability awareness in the GCC region. However, in order to develop a new Green IT model, it is essential to fully understand the factors that promote or prevent the adoption of a Green IT and sustainability model in the GCC region.

3.3.2 First research sub-question and objective

- Question: What are the opinions of various stakeholders in GCC countries concerning the Green IT model?
- Objective: To gather the opinions of various stakeholders in GCC countries concerning the Green IT model.

“Green IT involves many areas and stakeholders, starting from governments, through new business models and R&D, to different technical field “ (Ardito and Morisio 2014, p.25). In business, stakeholders are the key to a successful Green IT implementation as they do have access to the business tools. This research gathers and examines stakeholders’ opinions about the Green IT model in the GCC region. To answer the question, the researcher gathered data from top management personnel in GCC countries to ascertain their opinions about the Green IT model, and to discover new factors.

3.3.3 Second Sub Research Question and objective

- Question: How can a Green IT model be useful for IT departments in GCC countries?
- Objective: To study how a Green IT model will be useful for IT departments in GCC countries.

Green IT products are used to decrease environmental resource consumption and support business processes. For example, the use of large quantities of hardware, electricity and paper can be reduced by cloud computing. “Virtualization and cloud computing to increase the utilization ratio of already installed servers from 10% to more than 50%” (Mueen Uddin, 2012). Therefore, the second question aims to investigate whether the new Green IT model is useful for IT departments in the GCC region. To answer this question, the researcher collected opinions from IT personnel in regard to the new Green IT model factors.

3.4 Research Design

Saunders, Lewis, and Thornhill (2015) introduced the research onion design that is widely used in business research. The design has six stages that guide the research process. This research uses this approach to develop the research design. The first step (layer) is to choose the research philosophy then to decide the research approach strategies. The third layer is concerning the choice of an appropriate methodology: quantitative, qualitative or mixed-methods, followed by the research strategy. Then, the time horizon is decided. In the last step, the techniques and process for data collection and analysis are chosen.

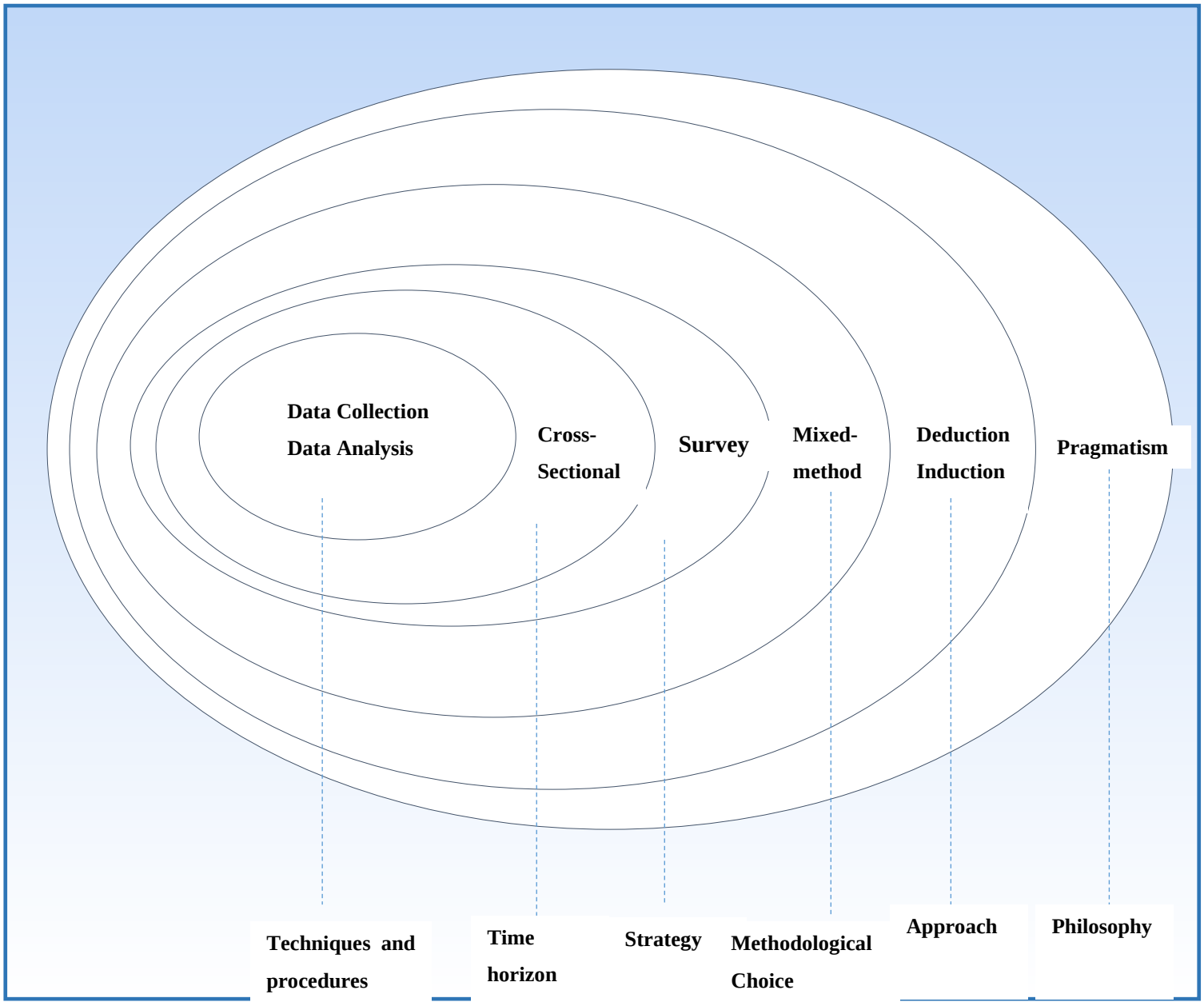

Figure 24. Research approach flow – Derived from (Saunders, Lewis and Thornhill, 2015), Adapted by Abdulaziz Albahlal

3.4.1 Research Philosophy in IS research

The first step to starting the research is to choose the appropriate research philosophy as shown in the research onion (Figure 24). Researcher philosophy is the way the researcher thinks about the developing research knowledge (Creswell, 2013; Saunders, Lewis and Thornhill, 2015). The main influence is likely to be the view of the relationship between knowledge and the process by which it was developed. It is likely that a researcher who cares about the facts, such as the resources needed in a manufacturing process, has a different opinion about research developments from the researcher who is concerned about the feelings and attitudes of workers towards their managers.

In business and management, research has four different research philosophies: positivism, interpretivism, pragmatism, and realism (Saunders, Lewis and Thornhill, 2015). Pragmatism is based on paradigms' plurality and has been supported by IS research (Goldkhul, 2012). For the ideal paradigm to be chosen, it is vital to compare all of them in line with their various research beliefs. According to Mertens (2007), the four main research philosophies are: claims regarding the nature of reality (ontology), how knowledge is being viewed (epistemology), ethical values that underline the knowledge (axiology), and the process which leads to such knowledge (methodology).

Research methodologies can be qualitative (making use of data that are non-numerical), quantitative (using numerical data), and a mixed-methods approach that combines both qualitative and quantitative methods (Teddlie and Tashakkori, 2009). Table 22 summarises the four research paradigms (Saunders, Lewis and Thornhill, 2015). The next section will discuss each philosophy in detail and justifies the chosen philosophy.

Table 22. Summary of four research paradigms by (Saunders, Lewis and Thornhill, 2015)

	Positivism	Interpretivism	Pragmatism	Realism
Ontology (Reality view)	Research is objective and socially-independent	Dependent on social view and subject to changing multiple times	The research accepts the best answer to the question as the research is external and there are multiple views	The research relies on understanding the social structures that contribute to the phenomenon, also the interpretation of the research is objective
Epistemology (Acceptable knowledge view)	Data must be observed (facts) and the phenomenon reduced to its simplest element	Dependent on the situation details and subjective meanings that motivate actions	Explores multiple views to acquire knowledge.	The research context should involve the social actors to bring knowledge. Structures and mechanisms cause the events.
Axiology (Research role of value)	Research is value-free, and the researcher is independent	The researcher is (subjective) as he/she will be part of the research	Objective and subjective perspectives are considered as values are essential	The experience and view of the researcher must be biased (value-laden)
Conducting data techniques	Normally uses quantitative data (highly structured); can also be qualitative.	Qualitative research is usually in-depth research from small samples	Mixed-method	All research methods are acceptable as the research is a view of reality (long-term study)

3.4.1.1 Positivism

Positivism is the philosophical position taken by the natural scientist and reflects the principles of adopting the research as a social reality (Saunders, Lewis and Thornhill, 2015). The investigator is independent and does not affect the subject of the investigation. It often recommends that the positivist researcher use a highly structured methodology to facilitate replication. The positivist approach relates to the empirical verifiability of the theories. Based on existing knowledge, the positive research approach adopts the deductive strategy to discover causal relationships between the knowledge elements (Orlikowski and Baroudi, 1991). Meanwhile, as Orlikowski and Baroudi (1991) stated, the quest of the positivist for generalisability may bring a picture of reality that is not accurate as a result of disregard for

the social context and who have actively played a part in the construction process.

3.4.1.2 Interpretivism

Interpretivism constructs are entirely different from positivism given that they seek to understand the social interactions of humans (Weber, 2004). During IS research, a researcher who is an interpretivist takes part in the enquiry with a view to understanding the IS influence and social setting (Klein and Myers, 1999). The strength of interpretivism lies in the fact that human interactions, as well as social contexts, are considered. However, this can also be a weakness since meanings will be derived from the interpretations and perceptions of participants. Results may be inaccurate once the participants err (Orlikowski and Baroudi, 1991).

3.4.1.3 Pragmatism

There have been many debates regarding the choice of interpretivism versus positivism in IS research (Chen and Hirschheim, 2004; Goldkhul, 2012). According to Becker and Niehaves (2007), positivists focus on the outcomes of their studies being valid objectively, while interpretivism tends to place more value on subjective perspectives being important during knowledge acquisition. Smith (2006) states that an alternative to both conflicting approaches can be found in by critical realism, which provides an objective view as well as a critique of reality.

However, this philosophy is not appropriate since the scientist does not challenge the system. It could also be due to history not being included in the agenda. A question that has surfaced is if a researcher is limited to one philosophy. Pragmatism is the answer to this issue, which involves various views and philosophies (Goles and Hirschheim, 2000). With pragmatism, the research question is at the centre of the problem, and in the search for answers, objective and subjective views are considered (Teddlie and Tashakkori, 2009). The pragmatist embraces pluralism, given that there are stages in the study or research where social interactions will be required. Teddlie and Tashakkori (2009) state that this takes place between participants and the researcher while others may require greater objectivity.

3.4.1.4 Realism

“Realism is a window to reality through which a picture of reality can be triangulated with other perceptions” (Healy and Perry 2000, 125). Also, “Proponents of this epistemological distinction often refer to the quantitative and qualitative research paradigms as positivism and

interpretivism" (Rolfe 2006, 306). Realism "is often seen as a middle way between empiricism/positivism on the one hand, and anti-naturalism/interpretivism on the other, thus introducing a more nuanced version of realist ontology" (Zachariadis, Scott, and Barrett 2013, 2).

Therefore, critical realism is based on the philosophy that knowledge is being sourced or generated from different causal mechanisms, as this interaction will explain more about the research problem (Mingers, Mutch and Willcocks, 2013). Tsang (2014) states that in IS research, the major aim of critical realism is to ensure that phenomena are objectively explained within a particular social context. In addition, the aim is to make use of an alternative lens in examining IS to challenge the critique as well as status quo. The IS' tacit role is also looked at in organisations as a way to suggest changes (Smith, 2006).

According to (Cecez-Kecmanovic, 2011), in IS research, critical realism focuses on examining the history of information systems in organisations with a view to challenging the regimes of truth. It is also aimed at studying those transformations, which are a result of IS. Critical realism thus favours longitudinal explorations based on historical studies and ethnography, which can be very time-consuming (Orlikowski and Baroudi, 1991; Saunders, Lewis and Thornhill, 2015).

3.4.1.5 The selected paradigm

As this study is aiming to develop a Green IT and sustainability model for GCC countries, the adoption of one paradigm is appropriate. Therefore, a perspective that is more diverse and can benefit from the strength being offered by different paradigms, minimising their respective weaknesses, as well as being appropriate for acquiring a comprehensive understanding of Green IT and sustainability, should be embraced. Ontologically, this is a combination of rigour as well as objective validity with social constructivism details.

In epistemology, it is better to explore different approaches to acquire a better understanding of the subject. Methodologically, it was sought in the diversity of approaches or mixed-methods which have advantages both qualitatively and quantitatively. Although past studies are not included in the research, its critical slant towards ensuring that GCC organisations improve to the Green IT and sustainability model adds validity to its findings. Therefore, the researcher found that pragmatist philosophy is suitable for this research and will guide the research design as shown in Figure 25.

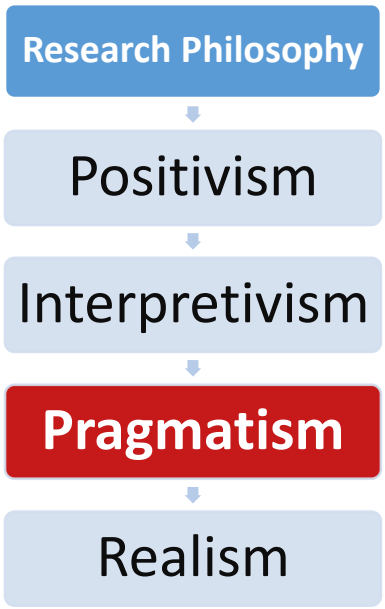

Figure 25. Pragmatism is selected for the research philosophy – prepared by the researcher

3.4.2 Research approach

After the choice of paradigm, the second layer of the research onion as shown in Figure 24, requires choosing the research approach. Two different research approaches were used: inductive and deductive. These approaches depend on the literature used as a starting point for the research. The deductive approach aims to prove whether a theory is wrong or right by measuring, testing, and generation of hypothesis, while the inductive approach is simply based on data collection, through the collected data, patterns, as well as meanings that will be arrived (Gray, 2018).

Hence, the major aim of this research is to develop a Green IT and sustainability model for GCC countries. Hence, a broad base is maintained, which will be narrowed down as more findings are made over time (Saunders, Lewis and Thornhill, 2015). Both inductive and deductive approaches are appropriate for this research as shown in Figure 26, and have been used in this study as no hypotheses have been established since a sequential exploratory research design is applied (explained in section 3.5.2).

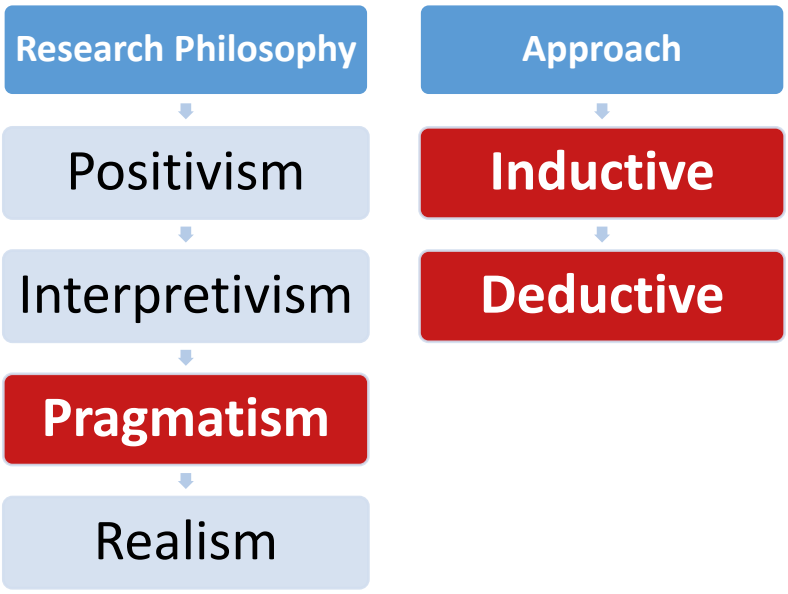

Figure 26. Both inductive and deductive approaches are selected – prepared by the researcher

3.4.3 Examining research strategies

As the previous sections show, following the research 'onion' process, the researcher chose both inductive and deductive approaches, and selected the pragmatism philosophy. The next part of the research 'onion' focused on examining possible methods or research strategies. Research methods are clear activities undertaken in order to produce results (Mingers, 2001). The main purpose is to choose samples, the data collection processes and the methods used for data analysis (Rajasekar, Philominathan and Chinnathambi, 2013). Since the research is not investigating the effect of independent variables on dependent variables (Saunders, Lewis and Thornhill, 2015), trials were never considered as a probable research strategy. Instead, the investigation focused on inductive and deductive methods commonly adopted in IS research such as qualitative and quantitative approaches. The most popular methods in IS research are interview and surveys, then action research (Chen and Hirschheim, 2004). Additional methods considered for inductive IS research are grounded theory and ethnography (Myers, 1999; Urquhart, Lehmann and Myers, 2010). Each research strategy has its strengths, characteristics and limitations. For instance, survey is a quantitative research method whereby the data obtained from a sample can be generalised to the general population (Saunders, Lewis and Thornhill, 2015). However, the interview approach is qualitative, focusing on real-life experiences and opinions of the participants in regard to the research context (Yin, 2018).

After an analysis of the research strategies, three research methods were identified as not

being appropriate for the study. Since action research does not involve practical problem-solving, it was not seen as appropriate. Both grounded and ethnography theories were seen as the best strategies for the research because of their context-inclusive approach. The main challenge included uncertain or lengthy duration of the data collection process, thereby creating problems related to time; they too were rejected. Surveys and interviews were then identified as the best strategies for this research after these considerations as shown in Figure 27.

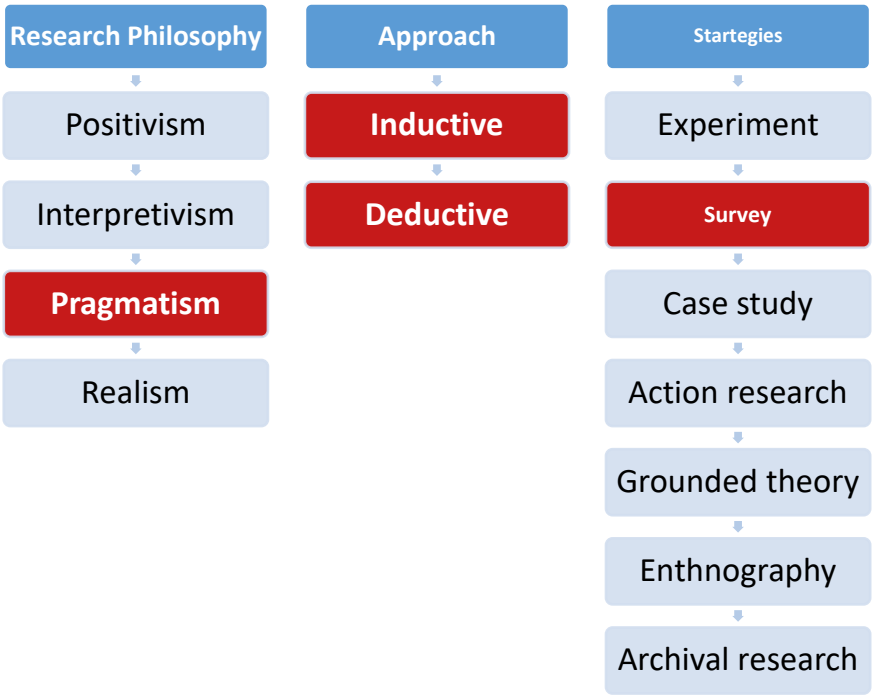

Figure 27. Survey and interviews are the chosen strategies – prepared by the researcher

3.4.4 Research methodological strategy

After analysing the several research strategies, the next layer of the research 'onion' required choosing the preferred method or combination of methods. The selection of a single strategy is known as a single method approach which may be either quantitative or qualitative. A mixed-methods approach is one that combines two or more strategies. A third possible approach is to combine different methods from various categories (Saunders, Lewis and Thornhill, 2015). The survey and interview methods required more analysis before selecting a research strategy.

The mixed-methods approach was chosen for this research as shown in Figure 28.

Mixed-Methods (MM) was selected for the following reasons.

- It combines both the survey and interview approaches, hence aligning with pragmatist research philosophy that advocates quantitative and qualitative perspectives (Teddlie and Tashakkori, 2009).
- A combination of the two strategies allows an extensive research by using various data sources (Greene, Carcelli and Graham, 1989).
- Because of clarification and triangulation of findings, the mixed-methods approach instils a high level of confidence in research outcomes (Greene, Carcelli and Graham, 1989; Venkatesh, Brown and Bala, 2013).
- The mixed-methods approach responds to calls to extend IS research to include more diverse views (Mingers, 2001; Chen and Hirschheim, 2004; Leech and Onwuegbuzie, 2009) and employ a range in methods that will yield more comprehensive outcomes for IS research (Mingers, 2001).

3.4.4.1 The interview approach

One of the most widely-used types of qualitative data-gathering methods is the interview (Mack *et al.*, 2005; Westerman, 2006; Creswell, 2013). Interviews are "optimal for collecting data on individuals' personal histories, perspectives, and experiences, particularly when sensitive topics are being explored" (Mack et al. 2005, 2). Therefore, in this research, interviews are conducted to collect data from personnel in different organisations who are familiar, to varying extents, with current technologies especially in terms of Green IT and sustainability. This is done to confirm the initial model's factors and to discover new factors.

Interviews can be conducted in different ways, one of the most traditional being the face-to-face interview. Recently however, the technology revolution has facilitated interviews via the Internet (e-mail and social media), telephone interviewing (Bolderston, 2012).

3.4.4.2 The survey approach

Several studies indicate that (Orlikowski and Baroudi, 1991; Chen and Hirschheim, 2004), the commonly used research strategy in IS research is the survey approach. It uses questionnaires for data collection while at the same time it is quantitative in its form (Chen and Hirschheim, 2004). Surveys are generally used in exploratory research because large amounts of data need to be collected carefully from a significant population within a short amount of time (Saunders, Lewis and Thornhill, 2015). The most appropriate strategy for this

research is the survey questionnaire as it enabled a comprehensive coverage of a large population sample from GCC organisations for Green IT to obtain their views bout and attitudes toward Green IT and sustainability.

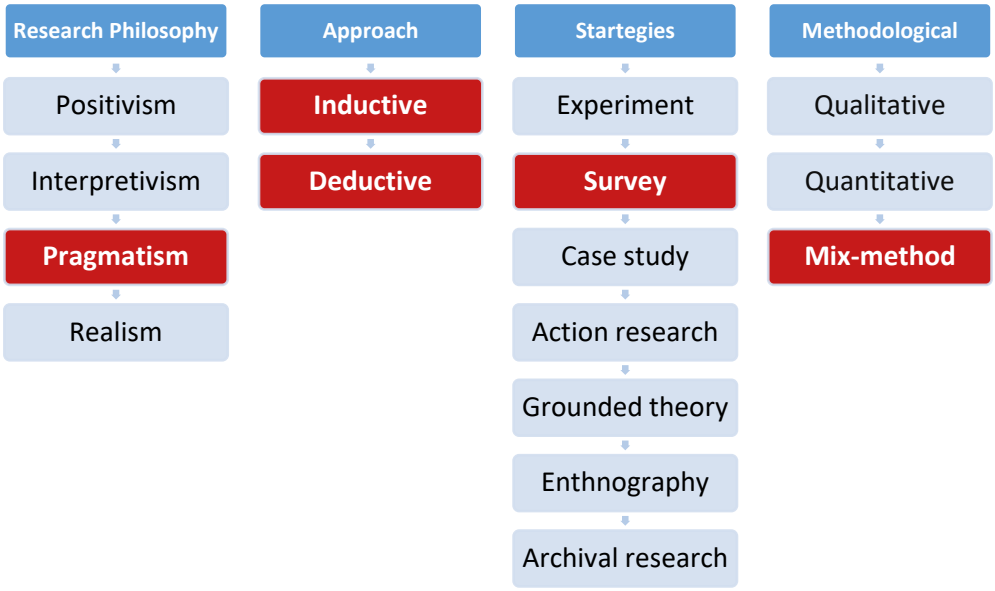

Figure 28. Mixed-methods approach is selected for the methodology – prepared by the researcher

3.4.5 Time horizon

The time horizon stipulated in the research 'onion' must be considered after the research strategy has been selected. This means that the outcomes of the research rely on obtaining a "snapshot" of the research sample at a particular time or via a number of observations over time (Saunders, Lewis and Thornhill, 2015). The cross-sectional approach gives a snapshot (Orlikowski and Baroudi, 1991), while an extended time horizon creates a longitudinal approach (Chen and Hirschheim, 2004). The longitudinal approach offers more accurate outcomes as the phenomenon of interest may change over time (Saunders, Lewis and Thornhill, 2015). In the case of this research, the cross-sectional approach for data collection was applicable for both survey and interview data because of time constraints as shown in Figure 29.

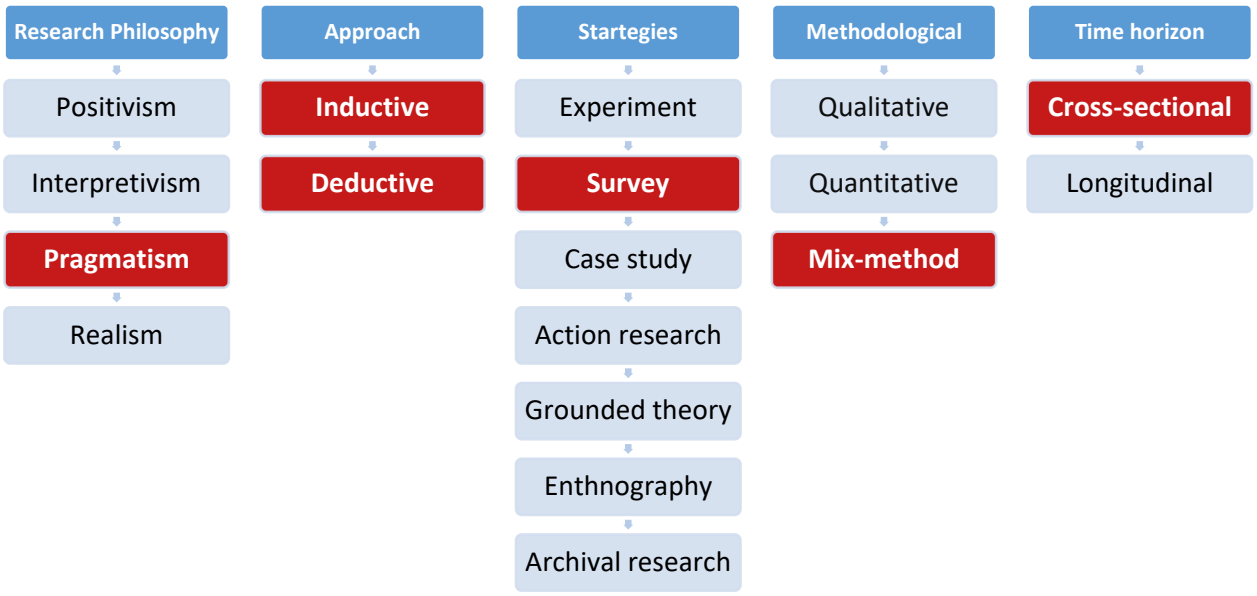

Figure 29. Cross-sectional approach is selected for the time horizon – prepared by the researcher

3.5 Data collection and analysis

The final part of the research 'onion' comprises the data collection and analysis processes. The research design establishes the processes for data collection and data analysis (Creswell and Plano Clark, 2017). In the case of this research, design included identification of the units of analysis, overall plan for the chosen mixed-methods strategy, and establishing how data collection and analysis will be done. These are detailed below.

3.5.1 Unit of analysis

Step one of the research design is the identification of the unit of analysis. This is about those groups, whole organisations or individuals, which would produce intended research results and indicate the source of data collection (Benbasat, Goldstein and Mead, 1987; Teddlie and Tashakkori, 2009). In the case of this research, the primary unit of analysis are companies in the Gulf Cooperation Council (GCC) countries. Since the study focused on Green IT and sustainability for organisations, it is worth noting that, in some instances, organisations were discovered to belong to a similar overarching group. For instance, they may have comprised a consortium or group of companies and were sharing similar IT executives and IT management, business and Green IT guidelines and characteristics. These were considered as one IT organisation.

3.5.2 Designing the mixed methods research strategy

Mixed-methods research has a number of design typologies. According to Plano Clark and Creswell (2008), there are nine options. However, the selected design summarised in Figure 30 shows that the choice of a mixed-methods typology depends on:

a) Time order of methods, such as concurrent versus sequential and

b) Method priority (Onwuegbuzie and Johnson, 2004). Techniques can be mixed as the investigation proceeds or can be an added dimension at the end Greene (2008). At the time of this research design, all these areas were considered.

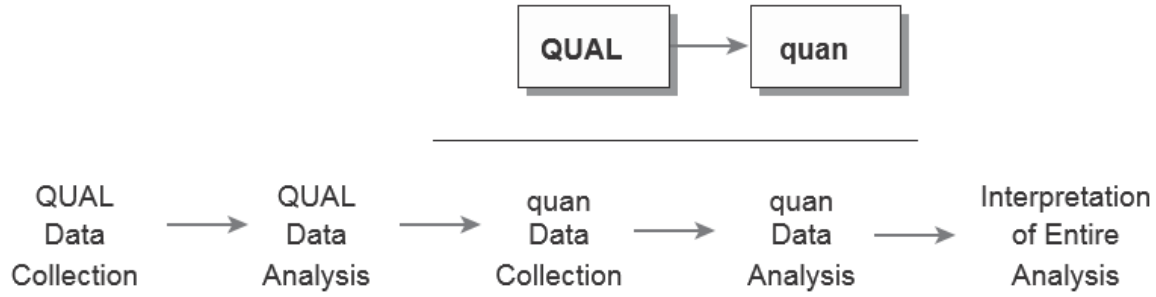

Figure 30. The selected sequential design for mixed-methods (Sequential Exploratory Design) - (Plano Clark and Creswell 2008, 180)

Consideration was given to sequential strategy in this research versus the concurrent time order option. This was done to enhance the findings by combining the outcomes of both techniques to provide a more detailed picture of the research scenario (Creswell, 2013). Minimal information is available on the current state of Green IT and sustainability in the GCC countries. In order to build the first Green IT and sustainability model, it was necessary to examine the current situation via qualitatively oriented interviews. This supplied appropriate material for further investigation through a survey and for the combination of outcomes. As such, an exploratory sequential design was selected. This typology begins with a qualitative collection of data and analysis (Creswell and Plano Clark, 2017). The topics chosen for the study led to the use of a quantitative (survey) tool for the investigation. Lastly, this was used to extend the research to a wider population (Johnson, Onwuegbuzie and Turner, 2007). Both quantitative and qualitative approaches are of equal value to the research. The next decision involved the integration of the two research outcomes. In the case of this research, survey results would both confirm the interview data and triangulate outcomes (Teddlie and

Tashakkori, 2009; Creswell and Plano Clark, 2017). The integration of the results of both methods will assist in the creation of a final Green IT and sustainability model as shown in Figure 31. The stages of mixed-methods design are further discussed in detail in the sections below.

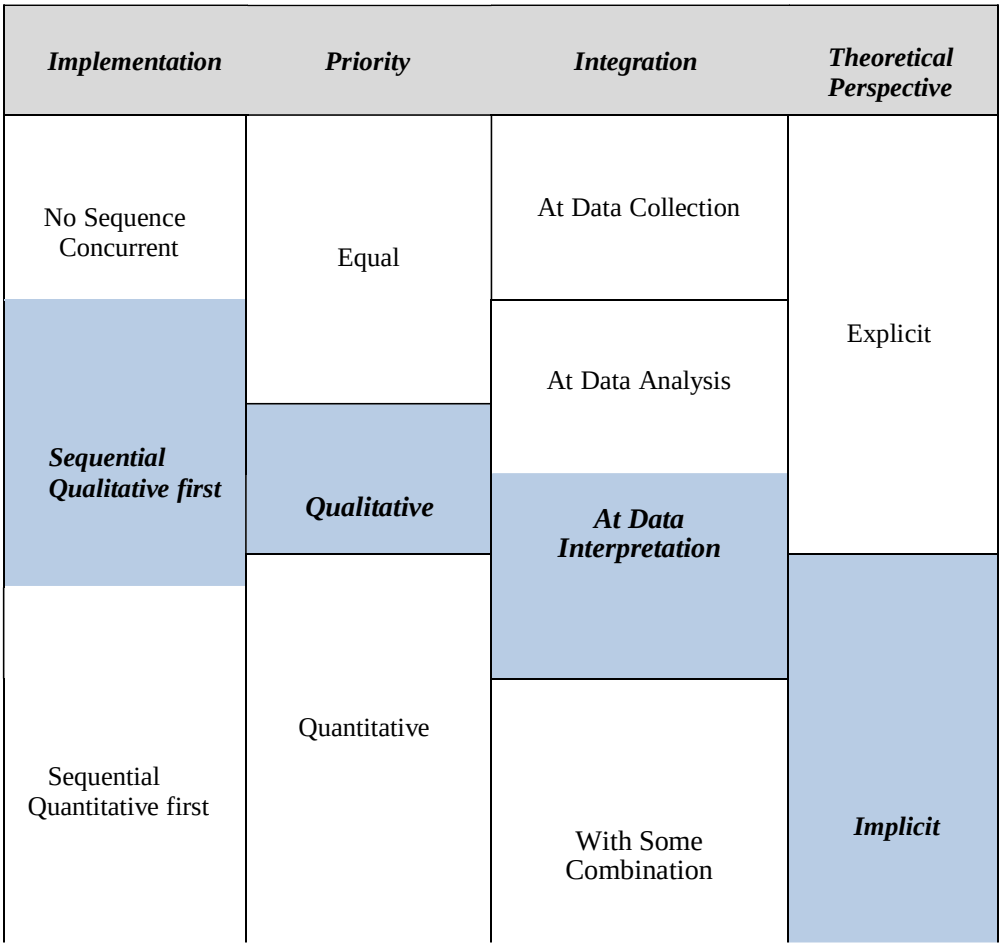

Figure 31. Selected decision matrix for determining a mixed-methods design – prepared by the researcher

3.5.3 Interviews

The most commonly-used method in IS research is the interview (Schultze and Avital, 2011). It is based on communication between two persons, whereby the researcher (interviewer) poses questions to an interviewee (Teddlie and Tashakkori, 2009). Interviewees are part of the research study and they add value to the collected data (Gräbner and Eisenhardt, 2007).

Interviews can be unstructured, structured or semi-structured (Saunders, Lewis and Thornhill, 2015). Unstructured interviews are usually flexible and open with no specific questions (Cohen, Manion and Morrison, 2017). Structured interviews, on the other hand, are formulated in advance and include a set of questions which are strictly adhered to (Cohen, Manion and

Morrison, 2017). Structured interviews are usually quantitative in form (Saunders, Lewis and Thornhill, 2015). Semi-structured interviews have the advantage of containing a predefined number of questions to control the interview while at the same time being flexible by allowing for additional questions (Saunders, Lewis and Thornhill, 2015). For these reasons, unstructured and semi-structured interviews are said to be qualitative and are specifically useful for experimental research which requires in-depth data (Saunders, Lewis and Thornhill, 2015). The semi-structured interview method was used in this research to maintain flexibility, allowing more information to be elicited to provide better insights.

Next to be contacted were the interviewees because they were directly under the supervision of the executive level management (ITGI, 2003; C. Peterson, 2004; W. 'RP' Raghupathi, 2007), CIO (Chief Information Officer) or Head of IT, CFO (Chief Financial Officer), COO (Chief Operating Officer) and CEO (Chief Executive Officer) who are members of the executive management of the target companies. They were identified through their various company websites and their contact information was obtained directly from the websites or via calls made to the company. In order to secure and arrange interview times, each executive member was sent a direct message either through email or social media, or by telephone.

Another item that required consideration was the reliability and validity of the interviews to be conducted (Healey and Rawlinson, 1993; Saunders, Lewis and Thornhill, 2015). Validity (goodness of data) is considered the biggest strength of qualitative interviews because they enable the researcher (interviewer) to provide clarification or request it, digging deeper for additional information and exploring the topic from another angle (Healey and Rawlinson, 1993). However, Yeung (1995) state that interview replicability or reliability can be questionable as a result of two kinds of bias:

- Response bias of the interviewee and interviewer (Miles, Huberman and Saldaña, 2019)

- Response bias occurs when an interviewee gives answers that are seen to conform to negative or acceptable organisational behaviour.

Interviewer bias takes place when an interviewers' body language, tone or language of the interview guides the interviewee to answer in a way not reflecting the truth (Saunders, Lewis and Thornhill, 2015). To manage the bias, research questions are given to the interviewees prior to the scheduled interviews so that they can prepare the answers (Saunders, Lewis and Thornhill, 2015). This reduces the chances of being influenced by the researcher (interviewer) or perceptions of the company. Interview reliability can also be improved by triangulation with other data collection methods (Yin, 2018).

In the case of this research, interviewees were given the interview questions prior to the interviews. Literature findings were used to triangulate interview outcomes where possible.

More details about the interview design and the participants are given in section 4.1.1.

After collecting the interview data, the researcher began to analyse the data using the themes that were derived from the literature review. NVivo version 12.0 was used as the primary tool to analyse the interview data, for its ability to organising the themes and export the final reports. Bazeley and Jackson (2013) states that NVivo was developed by researchers to suit their needs as it facilitates the organisation of data.

3.5.3.1 Analysing the interview data

Content analysis is generally used to analyse qualitative data (Zhang and Wildemuth, 2005). Hsieh and Shannon (2005) define qualitative content analysis as a research method used to interpret the content of text data via a logical classification process of identifying and coding patterns or themes. Also, Hsieh and Shannon (2005) categorise qualitative data according to three types of content analysis:

a) Conventional content – identification of codes directly from text (Observation)

b) Directed approach – identifying pre-defined themes from current research (Theory)

c) Summative content analysis – it involves comparing and counting key words

Content analysis is also categorised as inductive and deductive (Elo and Kyngäs, 2008). The inductive method entails identification of new categories through the grouping of similar emerging data under themes (Zhang and Wildemuth, 2005). The deductive approach entails validation of data belonging to categories identified in advance (Hsieh and Shannon, 2005), which can be derived through preliminary categories (Miles, Huberman and Saldaña, 2019).

Both conventional and directed methods were adopted for this research. Having considered a collection of ‘a priori’ themes or codes for Green IT and sustainability from literature, content analysis through the directed approach ensured that data belonging to current themes was deduced. The conventional approach is the best way to inductively analyse emerging themes. “In a conventional content analysis, categories are derived from data during data analysis “ (Hsieh and Shannon 2005, 1286). The draft of the Green IT and sustainability model that emerged from the interviews together with qualitative content analysis process is discussed in section 4.1.

3.5.4 Developing the survey instrument

After the interview process, the survey questionnaire was designed. Since the aim of the survey was to extend and triangulate interview outcomes, the questionnaire items were obtained mainly from the Green IT and sustainability model drawn from the literature review

and interview phase, together with additional new features from the literature. By doing this, the validity of content shows the extent to which the data instruments used to gather data covered the intricacies of concepts being explored (De Vaus, 2013). Hair et al. (2010) state that apparatus to be used has to be tested in advance to detect and solve any problems before administering the questionnaire.

Pre-checking the apparatus assists in ascertaining its face validity (De Vaus, 2013). The latter indicates the stage at which the contents of the apparatus seem to define ideas and is examined with the tool ratified by a number of people in order to see whether it is meaningful (De Vaus, 2013).

In this study, the questionnaire was checked by the research supervisors, IT personnel, and Green IT professionals before being finalized for executives. This study aims to obtain data from four categories of respondents: CEOs, top managers, non-IT employees, and IT employees. Subsequently, this was reduced to three categories: managers, non-IT employees and IT employees. Due to their particular function within their organisation, each participant will be asked specific questions for their category. Managers are not asked IT-related questions because they are aware of leadership; however, IT employees are the only ones required to answer the section on information technology. Table 23 shows the people targeted for this research, Questionnaire design details are given in section 5.2.

Table 23. People targeted for both survey and interview – developed by the researcher

	CEO	Managers (high-level)	Non-IT personnel	IT personnel
Governance	✓	✓	✘	✘
Information Technology	✘	✘	✘	✓
Social & Cultural	✓	✓	✓	✓
Green Management	✓	✓	✓	✓

3.5.4.1 Collecting survey data

In order to gather survey data, the researcher needs to identify the target population then select a sample and, finally, administer the survey questionnaire. Saunders, Lewis, and Thornhill (2015) advise researchers to pinpoint a target population which is very accurate, and that may mean using multiple sources of information. In this case, the target population of persons in high management positions in the Gulf Cooperation Countries (GCC) companies was determined using the (Bartlett, Kotrlik, and Higgins 2001) sample size calculator.

Subsequently, this target population was refined by making calls to as many organisations as possible to identify mergers and closures and to discover whether the organisations had a reliable IT infrastructure headed by an executive team. Websites and social media were also used to obtain additional information needed. Companies having similar practices, policies, CIO or IT managers as well as company executives were treated as a single group.

Probability sampling (random sampling) is a quantitative approach where all elements of the population have an awareness of the same opportunity of being chosen in a research as a subject. This is the most robust sampling approach that makes the study results generalized (Sekaran and Bougie, 2016). However, non-purpose sampling methods are acceptable for quantitative studies as long as a clear justification is given (Leedy and Ormrod, 2010; Creswell, 2013). Unlikely sampling can be determined by testing conditions (Creswell, 2013). The researcher chose to use purposive sampling approach that involves snowball sampling for a multitude of reasons during the quantitative process. The lack of a register available to the public for the entire GCC population from which the investigator can draw a random sample has discouraged the use of random samples. The researcher decided to include people with different backgrounds in GCC, including people with less experience of sustainability. It was expected that such a category could be under-represented or not at all represented if the researcher had used simple random sampling from available lists consisting of subsets of the total GCC population. The snowball sample encourages participants suspicious of conducting surveys if the test comes from their trusted counterparts.

After identifying the target sample populations, questionnaires were sent to relevant organisations that were initially identified as the target population to enhance the chances of obtaining reliable findings from a good response rate. Company executives and high-ranking managers targeted here are known to keep tight schedules while at the same time facing an avalanche of opinion requests from various sources. This results in profoundly low survey response rates (Cycyota and Harrison, 2002). Also, Cycyota and Harrison (2006) recommended that a 32% survey response rate by high ranking company managers is acceptable while Baruch and Holtom (2008) puts it between 35% - 40% as sufficient.

Once the population identification is over and the questionnaire completed, the survey process is ready to be carried out. This research targeted all company managers (business and IT included), non-IT employees and IT employees as research respondents. This decision was taken for four purposes:

- In the management case, the IT governance concerns mainly the high-level management (ITGI, 2003; C. Peterson, 2004; W. 'RP' Raghupathi, 2007), it still depends much on the contribution of managers and strong buy-in within all company levels (Ruey-Shian, Che-Pin and Sheng-Pao, 2013).

- Inclusion of Information Technology managers introduced an IT point of view in the survey data as most companies targeted from the identified target population did not have Chief Information Officers (CIOs).

- In the case of non-IT employees, the aim is to determine their level of understanding of Green IT and sustainability as well as the social and cultural effectiveness of these notions in the GCC region.

- The IT employees were the main target for this research and they were asked to respond to items that were the same for the non-IT personnel, with an additional section pertaining specifically to IT.

During the compilation of data for the targeted companies, a list of relevant CIOs' and IT managers' names, email addresses, telephone contacts and cell phones contacts was prepared for every company. Contact details and other relevant data were obtained through telephone calls to respective companies, and from liaison networks and company websites.

(Cycyota and Harrison (2006) also recommended using current CEO networks to collect contacts so as to improve the survey response rate. A cover letter inviting and requesting participation in the research (De Vaus, 2013) attached to a research questionnaire was sent to every potential participant. The cover letter outlined the objectives of the research and highlighted briefly the topic in order to improve the response rate (Dillman and Carley-Baxter, 2000; Cycyota and Harrison, 2006; Rogelberg and Stanton, 2007).

The cover letter and research questionnaire were distributed to the participants through their emails and were not sent by post or hand delivery except for those who wanted hard copies. Due to concern for Green IT and time constraints, the email transfer of both the questionnaire and cover letter were the best method of distribution.

Baruch and Holtom (2008, 1151) found out that surveys delivered via emails returned a 54.7% response rate compared to a 44.7% return of mailed surveys. Ensuring that every email is tailored to the participant and delivered directly to them improves survey response

tremendously (Dillman, 2011).

Qualtrics Survey Software was used to prepare questionnaire for online use. This format provided an added advantage in that participants were able to respond to the questionnaire quickly by completing it online. It also facilitated easy almost real-time tracking of the participation by the researcher as the questionnaire were returned upon completion, making it easy to conduct personal follow-ups. Both formats of the questionnaire were interactive, thereby improving the survey response rate (De Vaus, 2013).

In order to improve the rate of response, Saunders, Lewis, and Thornhill (2015) recommend carrying out follow-ups one week after the initial distribution of questionnaires. Follow-ups are an important means of keeping track of all potential participants who may have misplaced or did not receive questionnaires, could have been busy or just did not remember the survey (Rogelberg and Stanton, 2007). Carrying out follow-ups indicates the seriousness of the survey as well as the participation of respondents (Cycyota and Harrison, 2002).

To be more convincing to the participants, follow-ups were done through phone calls. In instances where participants were unreachable by phone, the researcher sent emails or messages as reminders. More information of the survey target population and participation rate of given in section 5.3 . In section 5.2.1, there is a discussion of survey structure, survey items and contents and the development of the survey questions.

3.5.4.2 Analysing survey data

Raw data obtained from research respondents were converted into information for analysis. For the purpose of analysis, numerical data was entered into a statistical data analysis application which also allows any errors to be identified (Creswell and Plano Clark, 2017). A codebook or coding scheme (Saunders, Lewis and Thornhill, 2015) with codes given to possible responses for every questionnaire item is first created. This helps to code appropriate questionnaire data numerically likewise to entering data in SPSS version 23 application and create a file. Upon receiving completed questionnaires, collected data was recorded and coded carefully to reduce typographical errors.

To avoid inaccuracies in statistical conclusions (Segars, 1997), confirmation as to whether survey matters depicted their corresponding mechanisms consistently (reliability) and accurately (validity) was done. Exploratory Factor Analysis (EFA) was applied to determine reliability and validity. This method produced similar results, confirming the theoretical expected behaviour stated by sustainability mechanisms and Green IT that the targeted population reliably and accurately depicted via the survey items. EFA was applied to show factors or latent variables in items related to the sustainability model and Green IT mechanism.

Based on the recommendations of Straub, Boudreau, and Gefen (2004) for information technology research, the explored forms of validity were:

a) Construct validity

b) Factorial validity and

c) Unidimensional validity

Construct Validity: determines the extent to which the items in the survey questionnaire actually record the basic factor principle or the underlying latent variable (Segars and Grover, 1993). This is established when factor items display both discriminant and convergent validity. While convergent validity determines the level to which items in factors are related, discriminant validity determines whether items across various factors are unrelated (Gefen, Karahanna and Straub, 2003).

Factorial Validity: ratifies whether all factors represent a single fundamental construct (Straub, Boudreau and Gefen, 2004).

Unidimensional validity: checks whether every item echoes only a single latent variable (Gefen, Karahanna and Straub, 2003).

Internal consistency was used to determine the reliability of every item for each factor. This determines the extent of the correlation between items as measured by the Cronbach's (1951) alpha index.

3.6 Putting it all together

Hair et al. (2010) recommends that combinations of data be interpreted carefully. A researcher could find that the model which fits the data in the long run is very different from the current model that was used for collecting it (MacCallum, 1986). Therefore, any changes made to a model must be carefully done while those items making model misspecification be retained because of their face validity (Hair *et al.*, 2010) and their theoretical grounding (DiStefano and Hess, 2005). So, to find answers for the research questions concerning sustainability model and Green IT for Information technology departments in Gulf Cooperation Countries (GCC), the ultimate model was crafted by combining the outcomes from the interviews and the survey. The subsequent model was strongly confirmed by the literature. This theoretically affirmed combination of outcomes enabled the examination of other alternatives as a means of extending and corroborating results.

3.7 Validity

Bartlett, Kotrlik, & Higgins (2001) Introduced a sample size calculator to calculate the number of people to be targeted by researchers. Firstly, the investigator should measure the size of the study population for this research, which is approximately 50,000 for all four areas of this study. The researcher then estimated the percentage error for this study at 6.5 percent. Finally, the researcher must ensure that the sample represents the population adequately to increase the trustworthiness of results. For this research, 95 percent is acceptable.

Based on the figures given earlier, 227 participants for both the pilot and the principal studies constituted the valid sample size for this study. The researcher suggested that six surveys, being at least one survey for each country in the pilot stage for testing before starting to conduct and distributing the main survey, would be valid. “Preceding the data collection, a pilot survey was carried out to ensure the reliability of the survey instrument; this pilot was conducted by a total of 6 academics, students and business analysts” (Richards, Marrone, and Vatanasakdakul 2011, 5).

For the interview, the acceptable number for this research is between 10-12 individuals. “In the qualitative pilot study, the aim is to interview about 10-12 individuals in 5-6 organizations using semi-structured, and open-ended interviews” (Babita and Sahu, 2011, 33). The researcher was required to obtain official approval from the targeted organizations in order to gather the research data.

Table 24. Validity numbers for this research – prepared by the researcher

Validity number				
	Number of validity contribution		**Population**	**Reference**
Survey	**Pilot**	6	500	(Richards, Marrone and Vatanasakdakul, 2011)
	Primary	227	50.000	(Bartlett, Kotrlik and Higgins, 2001)
Interview	10-12		100	(Babita and Sahu, no date)

3.8 Ethics approval

Research objectives were clearly explained, and respondents assured that all the data obtained from them would be confidential. To improve respondents' confidence, they were given the contact details of the survey supervisors and those of the researcher.

To guarantee a low-risk project, student researchers require the approval of the Ethics Committee of Curtin University. The approval form is titled "Request for acceptance of ethics authorization from another institute" and can be obtained from the Human Research Ethics Committee prior to commencing any stage of the data-gathering process. Every method must be approved, and the investigator then seeks permission to conduct the pilot study prior to the main undertaking. However, if any modifications are made, the researcher sends an amendment application form describing the intended modifications.

In addition, before research was carried out, all the organisations referred to in this research were notified of the research objectives. All participant information gathered for this study remains anonymous and confidential and every participant is entitled to withdraw from the investigation at any moment without giving an explanation. Information derived from the study is not shared with any other researchers or third parties. All participant interviews were carried out in English, except where the participant preferred to use Arabic. In this situation, a third-party translator was used for translating the recorded interviews. The documentation of authorization by the Ethics Committee was presented to assure respondents that they would not experience any loss of privacy, damage, pain or embarrassment in the wake of this study.

3.9 Research process flow chart

A summary of the research process is provided in Figure 32. Phase 1 (CHAPTER 2) contains the literature review for a clear understanding of the research context and to examine Green IT models for generation of a conceptual sustainability and Green IT model. Phase 2 (CHAPTER 4) Contains qualitative interviews, data analysis and outcomes in the initial draft of the sustainability and Green IT model. Phase 3 (CHAPTER 5) contains the survey data, and quantitative data analysis for the development of the final Green IT and sustainability model, which is discussed in detail in the final research phase. Chapter 6 presents the study's limitations, recommendations and proposals for future work.

Figure 32. Research process flow chart – prepared by the researcher

3.10 Chapter summary

This chapter discusses all the steps in the decision-making process for this research, guided by the research 'onion' comprising the research philosophy, research methodology, design and time horizon. The preferred research philosophy guiding this study is pragmatist philosophy because of its popularity and appropriateness for our research objectives. Inductive and deductive strategies were chosen as the most suitable given the exploratory nature of the research. A mixed-methods approach using quantitative and qualitative phases was chosen for answering research questions.

Interview data chosen for analysis helped in the drafting of the Green IT and sustainability model. Combined with additional materials from writings, it served as a background for the questionnaire design and administration of the survey. Exploratory factor analysis was used to help determine the reliability and validity of the research data. Research results were then combined to extend and triangulate results for the creation of the final model. Ethical considerations and the research steps shown in Figure 32 were discussed in this chapter. The next chapter is the first phase of data gathering from interviews and data analysis.

CHAPTER 4. INTERVIEW PHASE (Qualitative Analysis)

4.1 Introduction

The previous chapter established the research method for this study. In the first phase, interviews were conducted with managers in GCC companies for the purpose of gathering data. The interviews enabled the researcher to examine all the factors found in the literature review by asking each interviewee a question related to each factor. The Exploratory Sequential design was chosen which gave the researcher the opportunity to explore the phenomenon of Green IT in GCC countries. This design was introduced by Creswell (2013): "An exploratory sequential mixed method is a design in which the researcher first begins by exploring with qualitative data and analysis and then uses the findings in a second quantitative phase" (Creswell 2013, 275).

The researcher obtained the data for this phase from seventeen interviewees who had top management position in companies within the GCC countries. Interviews were conducted face-to-face. The interview data obtained from coding and analysis conducted in this phase were used to design the questionnaire for the online survey. Some of the interviewees lacked specific knowledge about some of the factors. For instance, managers in marketing departments usually have little or no knowledge about the installation of virtual machines; this is a subfactor that is relevant only for people in an IT department. Thus, some of the interviewees were not asked some of the questions, since IT-related questions were appropriate only for IT personnel. NVivo software Ver.11 was used for coding and analysis, enabling the discovery of more factors from the "most-mentioned word" feature.

4.1.1 Interview design

In this chapter, the researcher describes the advantages of semi-structured interviews and how the interview data were analysed. In addition, the researcher describes how questions for the next phase (internet-based survey) were obtained.

The interview strategy is one of the most popular methods used for conducting qualitative research (DiCicco-Bloom and Crabtree, 2006). There are three types of interviews: unstructured, semi-structured and structured. In the unstructured interview, generally the researcher asks the interviewee open questions and then formulates the next question according to the previous answer. “The investigator identifies one or more ‘key informants’ to interview on an ongoing basis and takes jottings or short notes while observing and questioning” (DiCicco-Bloom & Crabtree 2006, 315).

In the semi-structured method, open-ended questions are asked as well as a limited number of set questions to keep the interview on track. The semi-structured in-depth interview is the most commonly used method for obtaining data. DiCicco-Bloom and Crabtree (2006) states that usually take between 30 minutes to several hours to complete only once for an individual or group.

Lastly, the structured interview is conducted using closed-ended questions given to the interviewee with a choice of responses from which one is chosen. The semi-structured in-depth interview was chosen for this research as it fits the researcher’s requirements for the final model. Peng & Annansingh (2013, 277) state, “Semi-structured interview is a very efficient tool to collect in-depth human insights to explore a list of themes and questions that are predefined prior to the collection of data”.

The process of data collection from interviews has six stages. The first task is to establish the research objectives. Then the interview questions are formulated, based on the literature review, or the answer to the previous question. After that, the questions are grouped according to their appropriateness for a specific research category of participants. Then, data from each interview is documented and stored so that it can be accessed by the supervision committee. Lastly, the interview data is analysed using the NVivo V.12 application as the main tool for coding and analysis. This process is shown in Table 25.

Table 25. Sequence of tasks for collecting the qualitative data – developed by the researcher

No.	**Task**	**Description**
1	Establish the interview's objectives	The main objective of the interviews is to discover new factors and help to improve the original model.
2	Formulate the interview questions	Each question was investigated in a various academic paper. As part of the conceptual analysis that has been chosen for this research, interviewees were asked questions that included factors about which their opinions were sought.
3	Decide on the target sample	The researcher sought interviewees who were in management or executive positions, with sound experience, particularly in IT departments.
4	Conduct the interviews	It took the researcher about two months to conduct all the interviews; the researcher needed to travel to some of the GCC countries to conduct face-to-face interviews.
5	Documentations	All interviews were reordered and transcribed, and the conducted data is accessible to selected people.
6	Analysis	The researcher used NVivo software version 11.0 for coding and all the NVivo's files were stored in a safe location and accessible to a limited number of people.

4.1.2 Interviewee's acknowledgement

In order to find participants willing to be interviewed, firstly, the researcher sought potential participants in Saudi Arabia, which is the largest country in the GCC; secondly, the researcher sought potential interviewees in other GCC countries. Each participant held a managerial or executive position, either lengthy work experience or high qualifications. For example, one of the participants from Kuwait has a Bachelor degree in Human Resources and has 25+ years' experience in HR, and a participant from the UAE has a Master degree in Public Relationship from Sweden and has 6+ years in business and operations as shown in Table 26. In all, seventeen participants were obtained, which is above the validation number required for this research.

In the first stage, in Saudi Arabia the researcher was supervised by the Chief Information Officer (CIO) of a Saudi government organisation. This supervision enabled the researcher to

use the organisation's network to encourage personnel in other organisations to participate, especially those in managerial positions in Saudi Arabia. The support document is provided in Appendix 3. This supervision gave the researcher the opportunity to interview six people in high management positions in Saudi Arabian organisations. The number of participants from Saudi Arabia is higher than for other GCC countries as Saudi Arabia is the largest country in the GCC region. "Saudi Arabia is the largest Gulf Cooperation Council (GCC) state located in the Arabian Peninsula with a population of approximately 27 million" (Alakloby 2012, 53).

The second stage required the researcher to travel twice to Dubai; the first trip was on the 9th of October 2016 to interview participants who had accepted the invitation through the Saudi's supervisors. During this trip, one of the interviewees suggested that interviews with participants from other GCC countries could be conducted by the researcher attending the Gulf Information Technology Exhibition (GITEX) rather than travelling to each GCC country. The researcher accepted the new idea. The researcher returned to Saudi Arabia to await the commencement of the exhibition. On the 15th of October, the researcher travelled to Dubai to conduct all other interviews. Lastly, conducting the interviews in GITEX was a valuable chance for the researcher to find high-positioned interviewees in one place.

Table 26. The interviewees' qualifications, experience and positions - developed by the researcher

Bahrain Kuwait Oman Qatar Saudi Arabia UAE

	Participants	Country	Participant's level of qualification and employment
	Participant A	Bahrain	Master degree in information security from the USA. Has 9+ years' experience in business analysis. Head of the research and development department. Appointed as Ambassador of the convention. Leader of human development informatics system. Received the Bahrain e-content award for health and environment.
	Participant B	Bahrain	Master degree in Marketing from Bahrain. Has 5+ years' experience in marketing. Head of marketing department. Named best employee by his organisations in 2015. Received award from Nasser bin Hamad Youth Creativity for science invention.
	Participant C	Kuwait	Bachelor degree in Human Resources. Has 25+ years' experience in HR. Head of HR & Recruitment Management department.
	Participant D	Kuwait	Master in Computer Science; 16+ years' experience in oil and gas sector. Director of IT Project Management Department.

	Participant E	Oman	MBA degree from the UK. Has 8+ years' experience in Information Technology sector experience. Position is the CIO of his organisation.
	Participant F	Oman	Bachelor of Information Technology from Oman. Has 10+ years' experience in computer science and business analysis. Director of the technical department in his organisation.
	Participant G	Qatar	Master of Business from the UK. Coordinates ICT risk management activities in line with Enterprise Risk Management Framework. Coordinate external/internal ICT audit exercises. IT analyst and team leader of analytic team. Has 15+ years' experience in IT
	Participant H	Qatar	Master of Electrical Engineering from Qatar. Project Management and Contracting Strategies. Engineering Effort Estimation / Cost Estimation. Technologies Evaluation, Technology Development. Has 20+ years' experience in engineering and oil.
	Participant I	Saudi Arabia	Master of Information Technology from the UK. Director General IT Department. He has 21 years of extensive experience in all aspects of IT development and management. Has good experience in Green IT and sustainability, and has already started to apply some of Green IT concepts. Experience derived from Maser study in the UK.
	Participant J	Saudi Arabia	Master of International Business from France. Key Account Manager. Providing business recommendations based on Big Data analytics. Has 6+ years' experience in business analysis.
	Participant K	Saudi Arabia	Bachelor of Information Systems Engineering from Malaysia. Leading team of business developers and business analysts. Business Analyst in MOI Portal. Has 8+ years' experience in the technology field.
	Participant L	Saudi Arabia	Master of Computer Science and Software Engineering. IT project manager. Manager and E-Government System Operator. Has 10+ years' experience in IT and business analysis.
	Participant M	Saudi Arabia	Master of Computer Software Engineering from Australia. Technical Development Manager. Mandated to implement and operate SAFEER program. He has 9+ years' experience in IT development and operations.
	Participant N	Saudi Arabia	Master of Business Administration from USA. Director of IT department. Experienced in IT and innovation. Has 12+ years' experience in IT technical and business analysis.

	Participant P	UAE	Master of Public Relations from Sweden. Director of developing new business department. Has 6+ years in business and operating. Has experience in business start-ups, and gaudier for start new business in Dubai.
	Participant Q	UAE	Master of Science from the UK. Director of business analysis office. Has 16+ years' experience in business.
	Participant R	UAE	Master of Design from Dubai. Director of design and innovation department. Has 8+ years' experience in design and user experience applications.

Before conducting each interview, the researcher arranged and confirmed the location and date, and gave the interviewee the necessary information about the interview. Also, the interviewees were asked to read and sign a consent form and give permission for voice recording. Thus, all the interviews were voice-recorded and accessible to the researcher.

Also, according to ethics requirements, all the interviewees were told that they had the right to withdraw from the interview at any time with no consequence. Some of the interviewees made very interesting and relevant comments and asked the researcher to provide the results of this research, to enable them to start applying the Green IT concepts in their organisations as they believed that this would be valuable for business sustainability. Some organisations had already hired foreign expertise to apply some of the green concepts in their organisation, as Green IT knowledge is very limited in GCC regions. The percentages of interviewees according to country in the GCC are: Bahrain 12%, Kuwait 12%, UAE 17%, Saudi Arabia 35%, Qatar 12% and Oman 12%.

4.1.3 Validity and Reliability

Galvin (2015, 4) states that "It is the exception rather than the rule to find more than 20 interviews, and 8–17 is by far the most common range "; and he added "From a purely statistical point of view, there is a 16.7% probability that a belief held by 10% of the relevant population will not have emerged after 17 interviews". Thus, according to Galvin (2015), the number of interviewees was acceptable for the validity and reliability of the data. The researcher's supervisor, academic colleague and managers in Saudi Arabia reviewed the interview questions. A number of questions were modified or deleted because they lacked clarity for the managers or were not related to the main topic. Also, the researcher received positive feedback from those reviewers and asked each one of them about the quality of the

questions as the main consideration. Mixed-methods research integrates and combines both quantitative and qualitative methods to investigate the same topics in the same study (Leech and Onwuegbuzie, 2009). The results of the interviews provided guidelines for the formulation of items for the online survey questionnaire which was the quantitative component of this research.

4.2 Data Analysis, Coding and research factors

Data analysis in qualitative research requires certain flexibility and creativity in data analysis. Data analysis needs the researchers to be familiar with classifications and make comparisons and contrasts, and the researchers must also be open to the opportunities and see opposite or alternative reasons for the results (Creswell, 2013).

According to Zhang and Wildemuth (2005), content analysis is a common way to analyse the transcripts of interviews to obtain people's ideas (Hsieh and Shannon, 2005). Qualitative content analysis involves compiling raw information into classifications or topics depending on legitimate interpretation and inference (Elo and Kyngäs, 2008). It is advisable to start quality content analysis in the early stages of data collection (Miles, Huberman and Saldaña, 2019). This early implementation of content analysis will help the investigator to switch from development to data collection, enabling collected data to be converted to information that is relevant for research findings.

The researcher took two steps, recommended by Miles and Huberman (1994), to analyse the interview data. In the first step, individual scripts were read and analysed; in the second step, all scripts were analysed collectively. The sequential process of the analysis is shown in Figure 33.

For the analysis of individual data, the content analysis procedure described by (Tesch, 1990) was conducted. First of all, the researcher compiled data using the descriptions of the participants to transcribe all recorded conversations. The 17 transcribed interviews produced 178 pages of transcripts. A sample transcript is provided in Appendix 1. Second, the investigator used each subject as the analytical unit. The researcher is mainly searching for expressions of a concept when using the theme as the coding unit, so a code can be added to a text piece of any size provided that this piece constitutes a single theme or problem of interest to the study question (Zhang and Wildemuth, 2005).

Third, because deductive content analyses were used in this stage to analyse the interview

data, topics were created from the quantitative approach according to the pre-defined classifications (factors). Investigators can use preliminary classifications or topics from early stages of study, theories or models as the grounds of their topics when conducting deductive content analyses (Miles, Huberman and Saldaña, 2019). The categories from an earlier research model can be initialled and the model can be adjusted if the latest categories arise from analysis. The researcher checked the seventeen transcripts carefully. During this phase, the researchers examined and identified the predetermined subjects and matched the relevant information to individual subjects.

The fourth stage was to eliminate any overlap when a single text segment was coded into several topics once the primary issues had been recognised (Plano Clark and Creswell, 2008). Lastly, the investigator then continuously examined the information and the topics so that new themes could emerge. To validate the transcripts, the interviews were revised several times to match the outcomes of the quantitative stage.

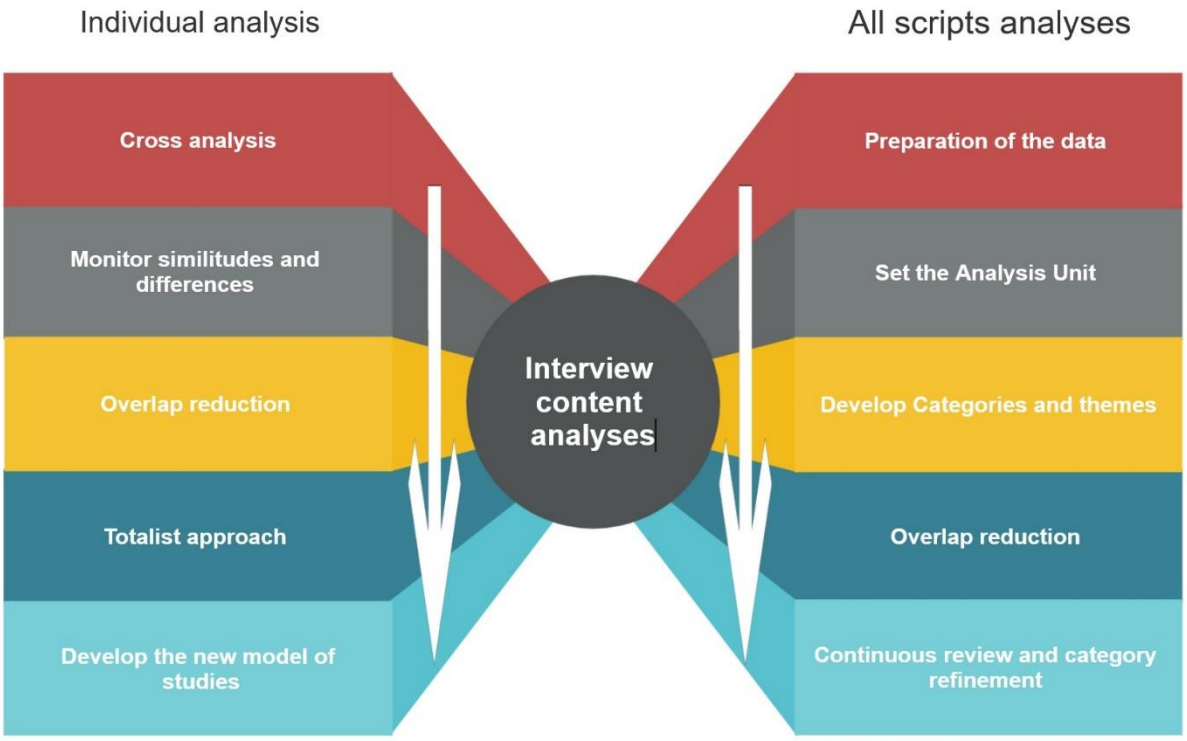

Figure 33. Interview content analysis - developed by the researcher

The researcher asked a general question to determine the participants' first impression of sustainability and its practice concerning the environment. The researcher intended to obtain an overall idea regarding the interviewees' practical application of sustainability principles. Surprisingly, most of the interviewees were keen and ready to apply green concepts in their personal lives. The question that was asked was "Sustainability is a term that is widely used

in different nations to maintain their practices and save the environment. Do you have a sustainable plan in your personal life such as waste recycling or using recycled materials, using renewable energy and purchasing only environment-friendly products? If so, why; if not, why not?" The answers to this question are shown in Table 27.

Table 27 participants' response for the general question

Participant	Answers
Participant A	I don't have any plan
Participant B	I never give attention to these concepts.
Participant C	I think we are influenced about this concept and that lead other companies to give us and explain about Green Solution in their products for me I return all old devices to company Al Wataniya Telecom this company has a recycling program so the accept all mobile devices, which is good.
Participant D	Me I don't have any plan.
Participant E	I don't have any plan in my life for sustainability.
Participant F	Personally, I don't have any sustainable plan fortunately that I know what sustainability is since I graduated from the United States and I studied some courses about sustainability.
Participant G	I don't have a plan to be honest with you, the reason might the lack of knowledge about sustainability might we need more awareness through the media about sustainability.
Participant H	I don't have any sustainable plan, me or my family, I'm know why, might the knowledge here in Qatar about sustainability is not clear and people did not take responsibility about it.
Participant I	We believe we can reduce the power consumption in the data centre because we have so many cabinet and servers and we do some modifications for the process and procedure just to make sure the power consumption in the data centre is efficient
Participant J	In general, my personal life in terms of buying environmentally products not however, I don't consider myself an abuser of the environment.

	Participant K	I have no plan for sustainability and I'm going Green because in Saudi Arabia there is nothing to motivate that from government and individual to go green.
	Participant L	Actually, no because I am not aware but I don't have enough passionate do that I really not care and use whatever available to go with my life.
	Participant M	Yes of course here in Riyadh we have been in the culture of having the recycling product and how we can separate these products in different type of garbage in our houses so that type of having the recycling.
	Participant N	Actually, no I didn't let say sustainable products and so on because of environment in our country.
	Participant P	In my personal life perspective at this moment living in UAE I don't have. I lived in other countries it was easy because the way or the model they are living in help such as if you go outside.
	Participant Q	Me I don’t have any Green plans, to be honest with you, I would put the blame on the knowledge about this field.

Most of the participants agreed on the importance of having a sustainable plan; however, they are not practicing sustainability in their personal lives, and have never considered it as part of their daily routine. The results show that GCC countries need to start a sustainability awareness program to encourage people to live without harming the environment. Also, some participants suggested ideas that would attract people’s attention in society, such as making them aware of products and the potential harm they can cause to the environment. In addition, the answers show there is a lack of knowledge in GCC regions regarding sustainability and the way to apply it. As one of the interviewees pointed out, one reason for this lack of knowledge is that sustainability is not taught early in school.

Fortunately, in Saudi Arabia, in 2013 they began an awareness program related to all cars, which means that any customers who buy a new car, will be able to see the fuel economy labelling requirements for the new car as shown in Figure 34. SASO (2013) stated “The label fuel economy limits were established to ensure alignment of the incoming fleet with the Kingdom’s fuel economy standard”, which is a part of the Saudi’s government’s awareness program.

Also, one of the Saudi participants stated that s/he does not have a plan because s/he receives no motivation from individuals or organisations. However, one participant from Kuwait stated, “I think we are influenced about these concepts and that lead other companies to give us and

explain about Green solution in their products for me I return all old devices to company a Telecom company has a recycling program, so they accept all mobile devices which is good". Moreover, a Qatari stated, "I do not have any sustainable plan for me or my family I do not know why the knowledge might here in Qatar about sustainability is not clear and people do not take responsibility for it".

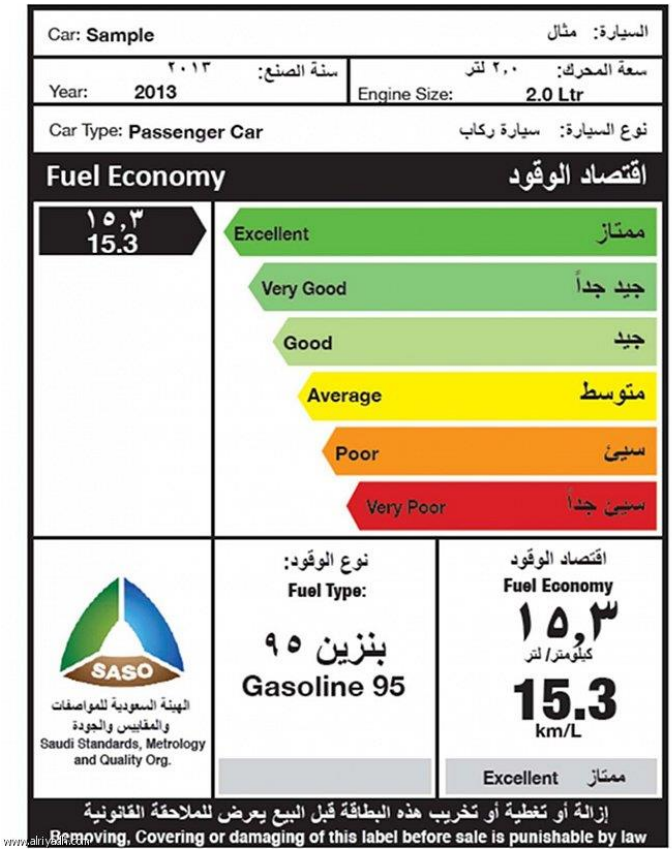

Figure 34. Fuel economy label for Saudis' cars

4.2.1 Governance

"Green IT governance helps companies structure their Green IT responsibilities" (Schmidt and Kolbe 2011, 4). Successful implementation of a Green IT model has different aspects, and one of the most important aspects is governance. GCC has its own political and legal issues. By considering these issues, the model will contain more accurate information enabling better decision-making by managers during implementation. "Social contexts and political environments still implicitly control Arab society and govern the development of organisational culture on IT" (Baker et al. 2010, 37). This factor has two branches as shown in Figure 35, which are legal and political; these two sub-factors will ensure the pre-implementation influencing decisions about Green IT implementation process from the top management, to ensure that there are no legal barriers.

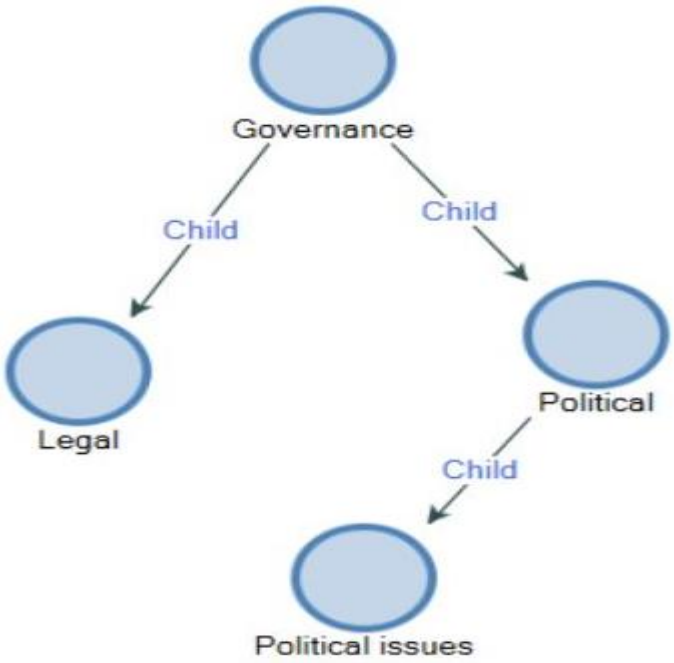

Figure 35. Governance factors with its branches – developed by the researcher

4.2.1.1 Political

In GCC countries, companies need to take the political factor into consideration when making decisions. For example, the business location and business owner will consider the political situation when planning to do business on a global scale. Therefore, any company decisions made in the GCC region might be rejected because of a political issue and location of the company. For example, if a business in a GCC country has decided to switch to cloud and the this cloud service is situated in a country that presents political difficulties, the decision will be dismissed. Therefore, research on sustainability in Saudi Arabia, conducted by Hashmi & Al-Habib (2013), suggests giving more attention to socio-political issues than emissions reduction.

Thus, this factor will give a better idea about any decision that might be influenced by political issues. Participants were asked two questions; the first question concerned the likelihood of a Green IT model being profitable for the government, and the second question concerns the political issues that might arise. The first question is: “Applying Green IT means that the organisations will reduce the usage of a natural resource such as power (oil and gas) and water. Do you think that the adoption of Green IT will lead your government to seek profits from other resources? If yes why, and no why?”. The responses to this question are shown in Table 28.

Table 28. Participants' answers for the political question

Participant	Answers
Participant A	I don't think so,
Participant B	I don't think these are any issue if we adopted Green IT, similar to any other product or solution
Participant C	I think will very hard to find other resources, they try to bring investments from aboard, but they fill to get confidence from the investors
Participant D	No, we are relay on oil, Kuwait needs a very long time to find other resources.
Participant E	I do believe that new technology came with different opportunities in business and employment
Participant F	finding other resources will be bit difficult, however we have a really good example in Dubai which change their business to focus on tourism
Participant G	think Qatar government will not change their resource anytime soon, here we herd that UAE minimize their usage of Oil to 75%
Participant H	I think Qatar relies on the gas as the main resource for our government, the change this direction I think will really hard to them to find other
Participant I	Yes of course when we reduce the power for
Participant J	Of course, as you know the country relies mostly on national resources which is oil and
Participant K	Yes, are you believe because once we do you reprocess and automate all government
Participant L	Yes, actually if you reduce the oil and the gas not depends and I think this the vision of my country Saudi 2030
Participant M	Yes, definitely since Saudi Arabia and many other countries have reduced the oil prices and economy in Saudi Arabia went to the peak 2010
Participant N	Yes, I think it will benefit our government the way they use the energy now is not optimised at all and the direction that we are going on the country is toward power saving, optimisation
Participant P	Yes, actually the government but a lot invests in relying less on oil Moore and Moore and one of them actually the green technology the best ways to come up with ideas
Participant Q	UAE government is diversification of income sources, they do have many projects in sustainability, here we have a city called Masdar

Participant R	I think UAE government already invests in Masdar city so I think they do have a clear plan for next step because the end will end because they already it is not sustainable sources maybe everyone needs to shift to

The answers to the first question depend on the location of the country. Participants from the UAE mentioned a sustainable project that was undertaken by the UAE government. However, there are some other sustainable projects in other countries, but due to the lack of media coverage, people are not able to know about these projects. Many participants agree that their government has already started to invest in sustainable resources to minimise the production of crude oil. Also, one of the main aims of the new Saudi Arabia Vision 2030 is to reduce the production of crude oil and shift to the use of more renewable energy.

A study by (Nurunnabi, 2017) to investigate the transformation of new Saudi direction from an oil-based economy to knowledge-based, found that within just one year, Saudi Arabia increased its non-oil revenue from SR136.5 billion(US36.4) to SR530 billion(US141.3). This plan was started recently by the biggest oil company in the world, Aramco, which acquired a number of non-oil companies including the biggest Petrochemical manufacturing company in Saudi Arabia called Saudi Basics Industries Crop SABIC. Saudi Aramco has agreed to buy SABIC for US69.1 billion (Rashad, El Gamal and Al Sayegh, 2019). Therefore, the main finding for the first question is the lack of media coverage. People in top management positions, once they hear about these sustainable projects, will be encouraged to apply sustainable practices in their workplace.

Then the researcher asked a further question as a sub-question for the political factor. The question was “Can you share with us what are the political issues that might occur if your organisations adopt Green IT?” This question aims to consider any political issue that might prevent the development and implementation of the Green IT model. The responses to this question are shown in Table 29.

Table 29. The responses to the sub- question for the political factor

Participant	Answers
Participant B	I don’t think there are any issues if we adopted Green IT, similar to any other product or solution
Participant E	I don’t think there’s any political issue might we see if we adopted Green IT.

Participant F	OK, I don’t think there are really a political issue in Oman as long as you adopting something good.
Participant G	Qatar government is a friend to other countries, so I think no political issues for adopting Green IT
Participant H	I don’t think there are any political issues to apply Green IT here
Participant J	Of course, as we see right now during these days how oil prices have affected a lot of political issue drive how the governments act and react to oil prices
Participant K	Well, there are no political issues as working in the Ministry of Education,
Participant L	My organisation which is a military organisation if we used sometimes if we use Green it for sensitive data which we want to provide all time on the IT environment we prefer to be in the document to give it more control so that's
Participant M	Well in our situation as an IT department for the ministry of education it is not that sensitive as much as other government organisation, so we have the security department and they have their concern about such areas as development manager
Participant N	I cannot name any political issues I cannot think of one currently for example they use off not clean energy the cost is the low minimum you could include the coat as low cost
Participant P	I think how much an issue of adopting green technology not in compliant with UAE laws even things are minor does not work with UAE so from future context does not much as long as in the same trajectory or in the same mission of promoting green technology
Participant Q	I’m not agree that will by a political issue if you adopted Green IT in Dubai, so I didn't think there will be any problem to adopt this field
Participant R	I can't see political issues in this Horizon the only things that I see how will adopt in everybody's life people are using paper cups or devices or old energy resources materials

From the responses to the second question, it seems that political issues require more attention, especially in regard to new projects in GCC regions. Some participants agreed that

it is challenging for some countries to establish a sustainable business with a country that has a political issue with them, as the region has its own political system that needs to be studied before any project begins. Participant J states “Of course as we see right now during these days how oil prices have affected a lot of political issue drive how the governments act and react to oil prices”. Ramli & Twaha (2015, 655) analysed a renewable energy model in Saudi Arabia making adjustments to an existing model used by a German company. One of the main findings of this analysis is that “a thorough examination suggests that the adjustment is more politically influenced than solid economic strategy”. Other participants did not see any political issues arising from the implementation of the new Green IT model. Participant L mentioned that some sensitive data could be hard to distribute since that will increase the possibility of being hacked; thus, the best way to secure this data is to use the traditional method.

4.2.1.2 Legal

A sound knowledge of legal requirements and regulations is one of the most important aspects of successful implementation of any new project. Therefore, this factor will take account of various items to ensure successful implementation; GCC countries are similar to other developing countries in that laws and regulations are updated regularly and quickly. The governance aspect of the final model has the ability to adapt to any new regulations. The new visions of these countries indicate future plans for sustainability, which will necessitate changing the current regulations. Participants were questioned about their ability and readiness to make changes to their current businesses. The question for the legal factor was “Organizations in developed countries are forced by law to reduce CO_2 emissions footprint, which led organisations to use a limited number of products that harm the environment. How would you overcome such a case in your organisations if a law applied from your government? Take into account that environmental products usually are costly”. The investigator asked this question to explore the response of organisations to any new legislation. The answers to this question are shown in Table 30.

Table 30. Participants’ answers to the legal question

Participant	Answers
Participant A	We have to follow what our government ask us to do
Participant B	Here in the ministry, the cost is not issue at all,

Participant C	We have to make a meeting in the management department to study new changes then send these changes to department who responsible about it.
Participant D	I don't had something like that before, but we have to make the changes in any way if the Ministry of Commerce asks to make it, prices I think not
Participant E	Here, we always forced to apply things that we are not comfortable with. I think if we forced to reduce CO2, we will find a suitable plan to the new
Participant F	If our government issues such a law, we don't have any other choice, we have to apply what they ask us for, I know the environmental products are costly however, the return price of these products is not long. That means is best for us since we are started our new vision to change
Participant G	Well, interesting question, I think we have to make a meeting to measure all damages to our business, then discuss our overcome plan, then we
Participant H	I not sure what I have to do, but as my government officials to change something on our business, we have to do it no matter about the price, because we will lose our business if we be against the law.
Participant I	Ok if it applies from the government, of course, it is costly, but I think we have many options, for example, we could go cloud with some services we can go virtualisation with some services, and we can switch off all
Participant J	Well basically this will lead to the inflation of the economy sense company hours forced and I think this is ready to apply in KSA for example the Saudi electricity company they apply some measures on the use of capacitor bank and all power management products which will lead to less CO2 emission and it could be expensive in the beginning but in the long term I think it will be more efficient so yes
Participant K	Actually, now the country have a vision of 2030 and one of the KPIs Of the vision is saving the planet and going green, so trying to force the government entities to automate processes and safe and saving the environment.
Participant L	I think in my organisation because we are very advanced company we use many pieces of equipment and that information technology is a high level my company I think implementing the Green IT if the government forced it will not be a problem because somehow as I told you we are a military company we have a technology transfer so most of our products transfer to other countries old developed in here in Saudi

Participant M	Well a time being Saudi Arabia government don't have the vision of reducing the CO2 specifically but on the other hand increase the efficiency for the Electronic Services and the IT products in general well if we in the ministry of education have been directed to have reduce the CO2 and increase the efficiency system

Answers to this question show different attitudes. Some participants intend to implement change by altering the business process to minimise the change-over costs, while other participants did not consider that the cost associated with change would be an issue. Participant K is expecting that legislation will soon be applied as part of the new Saudi Arabia Vision 2030. This answer indicates that the government of Saudi Arabia has a good awareness program for the new vision; hence, “awareness” will be added as a new element to the research model. In Saudi Arabia, some organisations have started to apply some of these aspects which will give a good indication of the way employees have been affected by change.

A survey was conducted by Surf & Mostafa (2017) to examine whether the Saudi’s 2030 Vision raised public awareness of sustainable practices. The results showed that “73.5% agree that sustainable building should be environmentally friendly and more 84% agree that sustainable buildings have low-cost, long term maintenance”. Thus, one of the questions that will be added to the survey questionnaire concerns whether the respondent’s organisation is applying any sustainable programs? If the answer is ‘yes’, the sub- question will ask how the program has affected the employee’s work practices and personal life. Overall, participants’ answers indicate that most of the business processes of these organisations are under development due to changes in the regulations, and there will be various improvements in the future since GCC countries are investing in technology and construction. Thus, a new layer for flexibility will be added to the research model enabling access to all the model’s components as shown in Figure 39.

4.2.2 Social and cultural

To achieve a successful implementation for Green IT model the researcher needs to consider the social and cultural. The improved research model has a main section named 'social and cultural'. This section has five factors that will show the effectiveness of the implementation, and whether it is positive or negative. Study results show that in the cultural context, employees' typical knowledge is influenced by the beliefs and actions of the managers in terms of adopting the technology (Baker, Al-Gahtani and Hubona, 2010). The coded node for this section is shown in Figure 36. Also, the investigation of participants' thoughts about social and cultural factors show various beliefs and attitudes.

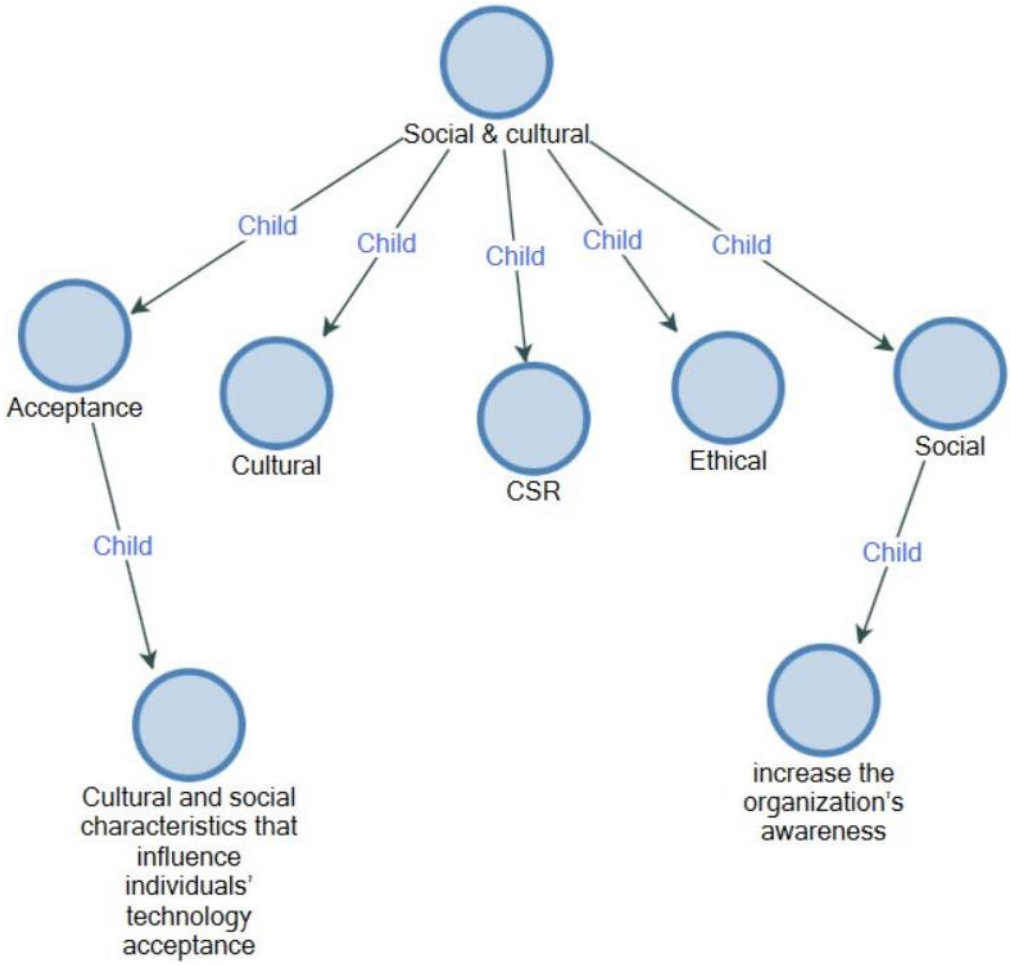

Figure 36. Nodes coded for social and cultural characteristics and their relationships - developed by the researcher

4.2.2.1 Social

The social factor aims to find the skills and knowledge in the GCC region that will increase people's awareness of Green IT concepts. Thus, participants have been asked a specific

question regarding skills and knowledge, and then they were asked a sub-question about awareness. The first question is: “Sustainability usually improves social and economic conditions for current and future generations, and also improves the quality of life and helps people to live in a healthy environment. What skills and knowledge are most critical to social changes regarding Green IT adoption in your organisation?”. the participants' responses to this question are shown in Table 31.

Table 31 Participants’ responses to the social question

Participant	Answers
Participant A	I think we have to focus on training
Participant B	I think employees need to be aware about Green IT before adopting, make people knowledgeable about it will raise the chances of successful implementation
Participant C	Yes, I agree awareness the most important step for acceptance.
Participant D	OK I understand it now yes, I think that awareness gives people the knowledge to help them in the decision support.
Participant E	Well I think the most important thing is awareness and knowledge about Green IT this method will raise the chances to make our company accept the new system.
Participant F	I think the most difficult aspects that might face is the old managers who are they find difficulties to understand and use new technologies, for instance, old people here are they refuse to use emails in our company, they still ask us to send an official paper to complete our business.
Participant G	Well, as I know most people of Qatar are young and they have the passion to change to better, social media application such as Facebook and twitter and others, I think this application is most critical things to change people knowledge, once we have a plan to change we have to reach influential people in these applications to change their mindset explain to them the advantage about Green IT, and then they can explain to their followers.
Participant H	I think first we have to change people thinking about Green IT, people might not know it very much, and once you didn’t know thing people not care about it, so I think we have to use the social media to change people thinking about Green IT and they know its importance.

	Participant I	I think it's all about the culture all this time all the IT team should be concerned about the green IT they should try improve their skills regarding to development, in general, try to reduce the power also read more about Green IT and what is the impact they will get from this kind of from this concept
	Participant J	So naturally people will not adopt the change that quickly if we depend only what the company is so it will be faster to have people adopt sustainable mentality if for example with the previous question the low forced, for example this also benefits the company as well when the law enforced by the government to make people buy those sustainable
	Participant K	Actually now the country has a vision of 2030 and one of the KPIs Of the vision is saving the planet and going green, so trying to force the government entities to automate processes and safe and saving the environment.
	Participant L	I think awareness program and continuous advertisement the idea try to implement cultural programs to make some certain people some key people some influence people to adopt this programs or this strategic objective to spread it around the companies mostly if you run it as a cultural program with a lot of awareness and sometimes putting rules and
	Participant M	Well here in Saudi we don't have the culture of haven't liked green environment and people didn't see the benefits of that yet so for my opinion I think if I were the decision manager here we should do a success story to let people see how success and how important that is so maybe after that we can manage how to improve and sustain the culture of the people
	Participant N	I think first things is changing the organisational cultural changing the mentality also teaching kids in the school the regarding to these concepts to mark up these concepts, for example, we have a good model in our country where people care about energy
	Participant P	I guess the most important knowledge is the actual awareness how important of such aspect are, over here things are changing so fast really really fast so in the way no propagating on what effects of these changes how fast they go they are changing for better but now government forcing people more and more to understand or install the concepts

	Participant Q	We have different tools to changes our people to believe in our products, we have first make them totally know everything about our product by give them training classes, we make them to visit the main factory to get the complete idea how our products made, so we focus on theoretical and practical to change our employees.
	Participant R	ok I see education is the most important skills in this adaptation and I cannot see anything else

Participants C, D, E, L and P are agreed that an awareness program is an effective way of delivering Green IT information to employees. One participant stated that “awareness gives people the knowledge to help them in the decision support”. Also, other participants mentioned that one of the objectives of Saudi Arabia’s new Vision 2030 is to save the planet and go green. “Vision 2030 seeks to transform Saudi Arabia's oil-dependent economy to one which is diverse and sustainable” (Jurgenson, Bayyari, and Parker 2016, 182). This finding shows how Saudi’s marketing team for Vision 2030 successfully uses knowledge about the level of awareness to attract key people to contribute ideas regarding the country’s direction.

Participants suggested changing people culturally by adopting an awareness program, which suggests that awareness might change people’s lifestyles. This notion of a cultural program was suggested by Baker et al. (2010, 50): “IT adoption and acceptance can be cultivated culturally with a higher probability of success using elites with an internal ‘progress’ perspective within a developing country’s beliefs and traditions than using external entities to force IT adoption.” One of the participants suggests using traditional ways to change people’s mentality by means of an internal program such as training or practical support. To change people’s behaviour and to give them an understanding of sustainability skills, training programs must be conducted that can lead to different methods of raising and educating children and training people (Bonevac, 2010).

The next questions were intended to investigate the level of Green IT awareness, as this is critical to the success of the implementation. Therefore, the participants were asked their thoughts about whether people would be aware of Green IT during the implementation process. The sub-question for the social element is “*Do you think that adopting a Green IT model will increase the organization’s awareness of the policy's importance in terms of sustainable business practices?*”. The participants’ responses to this question are shown in Table 32.

Table 32 Participants' answers to the social sub-question

Participant	Answers
Participant A	Might be, but I'm not sure
Participant B	Yes, as I said before.
Participant C	Yes, I agree, awareness the most important step for acceptance.
Participant D	OK, I understand it now, yes, I think that awareness gives people the knowledge to help them in decision support.
Participant E	Yes, as I just said that awareness is very important for all part of any new system, and adopting Green IT model will give the necessary knowledge
Participant F	Of course, will at least people will have an idea about sustainability and its benefits, and I think this the first step for any organisations who willing to change to Green IT.
Participant G	Off course yes, I think the first step to implementing Green IT, we have to give our people at least 3 sessions about Green IT and its benefits for
Participant H	I think yes, awareness is very important for the organization, once they adopted Green IT, they can see how it is very useful and important.
Participant I	Yes, for sure I think if we try to change their culture try to train the people to try to give the awareness about this concept I think will increase that organisation's awareness because all the people, not just the IT
Participant J	Indeed, yes it will help with the awareness as I mention in the previous answer
Participant K	Of course, yes actually all users of the system once they use it in the organisation and see how the efficiency of the system, they talk about it outside the organisation
Participant L	As I mentioned in the question before that yes awareness program will be a good thing to show the idea of the green IT to everybody around the organisation try to implement understanding and they will embitterment it not in the organisation they will implemented outside their organisation
Participant M	Yes, sure I think that will definitely change the awareness of the people and I think if we complete without moving to this direction we will face huge issues later on and everybody will not handle amount of problem that will become so I think awareness will be definitely great idea to implement

	Participant N	I think yes it will, at the end you have a limited number of the resources when your work with a green energy mentality you know that it's going to be sustainable sun still will be their solar energy will still be there however crude oil will finish at one day
	Participant P	Yes, as answered before I think most of the organisation will be awarded, also we will be applicability to apply it.
	Participant Q	Yes, we are now seeing the results after we just adopted Amazon AWS, people the saw how easy to use products online, and they can access our application from the web.
	Participant R	I don't see that it would increase direct impact I think most of the organisation firstly going to delay these policies and maybe the going to take their time to experiment the whole system if it is work or not they will work on it in big scale may be from the big players then they adopted otherwise I don't think they will do it quickly.

Most of the participants agreed that the adoption of a Green IT model would increase the organisation's awareness. People anticipate that there will be difficulties at the beginning of the implementation due to social resistance (Wagner, Vollmar and Wagner, 2014; Alqahtani and Issa, 2018). However, people will subsequently have a better understanding, and they will have confidence in the concept of Green IT. Also, one participant started to give a hint about the acceptance of these new models for his organisation. He said there is not going to be a direct impact, although the implementer should have a clear idea of the organisation's policies that might delay the implementation process for a certain time, especially in very large companies.

4.2.2.2 Cultural

The cultural factor is related to whether the adoption of a Green IT model will influence an individual's attitude to sustainability in GCC countries. Researchers from different fields found that cultural factors have a significant impact on successful implementation, especially regarding the acceptance of new technology. "*IT adoption in Saudi Arabia is influenced by explicit government policy in the attempt to enhance national and organizational productivity*" (Al-Gahtani and Shih 2009, 23). The question posed to interviewees is: "*Values and beliefs of an organisation's culture can impact the behaviour of individuals. How can an effective Green IT model adoption influence individuals' attitude?*". The responses to this question are shown in Table 33.

Table 33 Participants' responses to the culture question

Participant	Answers
Participant A	I think limited impacts
Participant B	Depends on the people, mostly they are not impacted here in Bahrein
Participant C	I don't agree that will impact people, I think they will learn how to work within the work, I mean people only will take as part of job.
Participant D	I think not that big changes. Green IT is a new field in Kuwait, people need time to know then might be effective, but as I told you we need time at least 10 years.
Participant E	Well, once people they use and see the Green IT benefits on work that will reflect to their personal life. People always influence form work since they stay at work for at least 8 hours, five days a week.
Participant F	I think I already answer part of this question on the previous answer, and I would add that since I graduated from the USA, I admitted that living on a country that cares about environment is change the individual's things, here in Oman no different, however, unfortunately, we don't have any awareness for induvial
Participant G	OK, I would say that will make people life much easier since as I know Green IT makes the new technology more efficient, and easy to use while our environment is protected
Participant H	I think people will use things that are familiar with, so once the company apply it and people like it, I'll say these people going to use it in their life.
Participant I	I think when it is become as a culture not just for that IT any SASO stuff will go with this so kind of concept, for example, he going to switch his machine when he left also he will switch the power he will switch the printer when they not using the printer he will also save the consumption of the paper of the printer so many applications so many thanks when we go awareness of the green IT
Participant J	It could impact the individual in the ways when you work in a company that selling or promoting green IT they will usually buy this product and then they will believe in it when you as employee believe in this and go home take this you with your family

	Participant K	Well, it will influence people and they will try to apply it in somewhere else like they are having any community and participants in home maybe so they would try to save the planet and going to green IT.
	Participant L	it will affect everybody whoever embitterment that idea once he leaves the organisation he will be in the same mentality outside that organisation because someone if you apply something in the company and when he goes out changed he will have a double identity so most people they don't have the double identity so whatever gains in somewhere and they believe in it and be implemented once they go out they will do the same
	Participant N	I think will improve the individual's attitudes some attitudes within the organisation or even invite your neighbour's street or weather with your family and let see friends some of them not optimised regarding power management, when you tell them, for example, turn off the light or turn off the air conditioner sometimes they didn't care however when you adopt environment friendly energy it will change their attitude and behaviour for sure
	Participant P	It will be not that efficient at the moment, to be honest right now people don't have this as a priority right now good to have in your the UAE, big companies like Microsoft Siemens and all these they have already imposed this in there company outside so bring it here with same mentality is easy but if you look at UAE companies
	Participant Q	Very effective I think, young people are keen to change to better, they did very good job to use latest technologies, we try to not stop them, we believe these people we're going to drive the country soon and they have to the patient to change as you know woman in UAE are now coming more effective and we hope they get better place in the future
	Participant R	I think it's going to be the most important thing but it's going to make a good impact actually in the individual attitude, but it is not going to be big critical

Participants gave various answers to the culture question. Interestingly, some participants were taught about sustainability as a subject during their studies overseas. Therefore, the teaching of environment-related subjects at university has a positive impact on the students, especially international students. Participant Q stated that it was "very effective. I think young people are keen to change to better they did a very good job to use latest technologies we try

not to stop them." This statement indicates the importance of delivering the sustainability message to young people through technologies such as social media.

Participant P stated that "it will influence people and they will try to apply it in somewhere else" and he added "so they would try to save the planet and go to the green". Hence, people will be aware of sustainability and take positive action by engaging in sustainable practices (Deniz, 2016; Surf and Mostafa, 2017).

4.2.2.3 Ethical

The ethical factor was intended to find how organisations in GCC countries are ethically motivating their employees to accept a new model. Organisations need to have a motivation plan before the implementation process to ensure that the new implementation is not at odds with ethical values (Barreto *et al.*, 2014; Kuppig *et al.*, 2016; Brockhaus *et al.*, 2017). "*Organizations can implement Green IT based on overall perception and beliefs of the organization and to do a common good*" (Thomson et al. 2015, 175).

Thus, the findings from the cultural factor will help the researcher to find the appropriate ethical approach to increase acceptance. The question for the ethical factor is "*The drivers of Green IT: economic, regulatory and ethical; also, Self-Motivation represented as the ethical driver during the Green IT implementation. How will your organisation assist individuals to ethically motivate, such as providing Green IT awareness during Green IT implementations*?". The participants' responses to this question are shown in Table 34.

Table 34 Participants' responses to the ethical question

Participant	Answers
Participant A	We have to hear from each one individually, and then complete the installation
Participant B	We do different plan for assistants, our works plan, is build a team that its aim to just assist people, then we do not move to next stage unless we receive a report from this team
Participant C	I think we will assist them using the email by sends questions that must be answered in a specific time.
Participant D	We are doing meeting twice a week, we as managers, normally, I will ask other manages to assist its employees about the new system,

Participant F	There are different ways to assist individuals, give them a survey about their understanding about Green IT before and after the implementation, make sure that there is time to do the second survey since individuals need time to use to and manipulate with the new change.
Participant G	Well, we are follow a plan called parallel implementation, so we have to make both systems work during the implementation, assisting people is one of these implementation steps, in the assisting step, we have to ask all employees individually through the email to any difficulties that had during last step, we will not move to the next step unless we solve all issues.
Participant H	I not sure how we will assist them, but normally we have a support team that responsible about the implementation including the assisting and other implementation aspects
Participant I	Actually, the self-motivation the time when we reduce when we do the action of the procedure for Green IT, for example when are you going to do request for the HR it will be faster and easier when we going to do it online via Green IT application instead of using paperwork services
Participant J	Actually, since the initial cost of these products that help with sustainability is expensive but on the long term is more beneficial than we usually come this point of view to explain that even if you invest in this point of time a high amount of money
Participant K	There will be two ways of awareness, direct and indirect motivations. So they can give them like a sessional and training of practising over the system so they can help also by forcing the employees to use the system rather than using the papers
Participant L	Yes usually most the big companies they will use the cultural program, cultural program means that you build a cultural inside the company in a certain things and that culture will be implemented by people by influence by people to another one and another one and will keep continuing until you get a full organisation will the closing mind to the thing so if you implement
Participant M	Well as I said before we should have a success story to follow so when people start implementing the green environment for IT specifically, they will see how important that is during other project working on the same area so when they see the advantages of that definitely motivated by their self

Participant N	people value and people looking being environmental energy not to waste Pure Energy and destroy the environment this would be taken as a religious motivation and it will greatly impact on people, plus other social motivation or even personal responsibility I feel responsible for the environment the Earth for our health even
Participant P	I wouldn't know actually if I had any exposure to green IT, then I would have given you better answer.
Participant Q	We have the only system for support, this system called ticket system, any employees can submit an issue ticket to solve it, this ticket will never close until the problem solved. But if ethically I think we have to sit beside all employees and explain to them IT issues that might occur, but unfortunately, we don't do that
Participant R	Ok actually I didn't think that organisation can assist on just one step or one plan I think it should be the whole system the whole country and the whole government are working on a big plan so they can be on this plan otherwise they can't go and make it by their own

This question drew a variety of responses; some participants said they use different methods to assist employees in their organisations, such as conducting training sessions for all employees. Participant F stated "… *give them a survey about their understanding of Green IT before and after the implementation*". This gives the organisation a clear idea of how to proceed when introducing a new idea and encouraging employees to accept it.

Participant L stated that "*most the big companies they will use the cultural program the cultural program means that you build a cultural inside the company in certain things and that culture will be implemented by people.*" Therefore, cultural programs have a positive effect on people in GCC countries. A cultural program encourages creativity and gives people new opportunities (Briguglio and Debattista, 2017; Cherry, McEvoy and Westskog, 2017).

Lastly, Participant M stated that "*we should have a success story to follow so when people start implementing the green environment for IT specifically they will see how important that is during other project working on the same area so when they see the advantages of that definitely motivated by their self.*" A success story for Green IT implementation is to motivate employees and have a positive impact on individuals.

4.2.2.4 Acceptance

Acceptance is related to determining whether a Green IT model will influence individuals to accept Green concepts. Participants expressed various opinions on this issue. Hence, the researcher asked a sub-question to elicit more detailed responses.

Acceptance of the concept is the first step to a successful implementation of Green IT since one of the main reasons for project failures is that people do not accept the new system during the implementation process. "*User participation is essential in the sustainable design, as well as to improve device acceptance amongst the users, and satisfy their needs*" (Issa and Isaias, 2015). The question is "*Do you think that Green IT model adoption will give the company more social acceptance in your country? If yes, why: if no, why* not?". The participants' responses to this question are shown in Table 35.

Table 35 Participants' responses to the acceptance question

Participant	Answers
Pa0rticipant B	I will say no, people here not have the complete picture about Green IT
Participant C	I think yes, people might know some of the aspects of sustainability in Kuwait
Participant D	Not that much, As I said before, people need to know Green IT first.
Participant E	Yes, as I said before, people always influenced by the place they are working in, especially in Oman, people here they are easy to affect with new technologies
Participant F	Of course, yes, people always searching for whom doing good in anything. Adopting Green IT will raise acceptance and gives more confidants for customers.
Participant G	Well, I would say that not effects in term of acceptance, we have to reach people, people never come to us and see what we are doing or what we applied in our business.
Participant H	I think yes, as I told you before, people are influenced by the company that work on it, here in Qatar we respect the company that we work on it.
Participant I	I think yes if we adaptability I think from the highly skilled people they will appreciate that and they will say SASO has a good reputation about that because as you know SASO is standard in Saudi Arabia we should adopt an international standard not just for IT for anything

Participant J	Well I think it is yes because when we know that the company which is investing in this country cares about the environment then definitely, we will have more acceptance socially
Participant K	I think maybe because the community are not aware enough about going green in the society but later with the influence of the employee when influence people outside
Participant L	If my organisation can implement a green IT so it is a public so what is a local company one of big local companies so in that place if you can implement a green IT I think in any other places you can implement the same ideas because that kind of people in that place is mixed from everywhere and with different backgrounds so if you can apply it that's mean you experimental can work out everywhere else in any organisation in Saudi
Participant M	I think they will after the implementation for such project they might see the advantages later on again it is changing of the culture so it might take time but definitely we will end up having great results from the public
Participant N	Currently I would say no because people don't yet understand green energy value and they don't yet value of a green energy concepts however in the coming of future or I will say just a few years green energy will be adopted more some companies are investing the government is moving to toward to optimisation so people at the end will be valued
Participant P	No, it does not do because it is no big deal here whether you are adopted or you don't but the customer at end of the day-care about its products over here so it doesn't matter.
Participant Q	Yah, I think so, people here know some of Green idea as promoted in the media, once they know that we are adopted Green IT, I think we will get nice reputation. And as I said before and hopefully this change coming from the media here anyway, we are really relying on the media
Participant R	I would say yes to some limits so it's not like 90 to 100% but I will say 50 to 60%.

Based on the participant's answers, it seems that social media is the most effective means of connecting to people in GCC countries. Organisations in GCC countries are using social media as the main vehicle for advertising their products. Participant D stated, “We are using media to make people accept our product, mostly the social media." Some products are socially accepted because they are promoted as being environmentally friendly. Participant J stated “… because when we know that the company which is investing in this country cares

about the environment then definitely, we will have more acceptances socially."

Then the researcher asked a sub-question, "What are the cultural and social characteristics that influence individuals regarding technology acceptance?" This question produced a variety of answers as shown in Table 36.

Table 36 Participants' responses to the acceptance sub-question

Participant	Answers
Participant B	I think media is the most influences things for individual, might through TV, radio, and twitter.
Participant C	I think twitter, Facebook, TV and other media are the most channels that change people's behaviour in Kuwait.
Participant D	We are using media to make people accept our product, mostly social media.
Participant E	OK, I think the social media is number one in Oman these days, using an application like Facebook and snapchat will easy to reach people here in Oman,
Participant F	I don't have specific characteristics; I'll say that people need understand first and then will be easy to explain them a characteristic. People need a confidant in Green IT.
Participant G	OK, Well, people in Qatar are using social media, between 5 to 6 hours daily, this rate is very high compared with other countries. Means the most character is using social media; I know people in Snapchat application that have more than 300 thousand view
Participant H	I think social network is most influence way to get people accepting, people here are using social network everywhere.
Participant I	I think the so many things that will be that influence the individual, for example, the newspaper the TV the videos the social media they can change the acceptance from the individual I think for the individual when they see shorts video from the people they like the celebrity
Participant J	I think in Saudi Arabia the characteristics of the people they care mostly about I mean they get the information from different sources but mostly from Friends is number one so pure effect is big in this and then the Internet all social network Twitter and all these things they affect a lot of people mentality

Participant K	Some of the people having more followers on Twitter or Facebook or Snapchat all other social media if they are having like 100000 or some of them have a million followers
Participant L	I think that social media is the most powerful things to implement such a character especially here in Saudi actually everywhere in the world that you can implement such a character to produce such ideas
Participant M	Well having the Internet over all the world in Saudi we have trend that all government sector should have an in the social media so we might have announcement or any direction that will affect end-user or public here in Saudi I would recommend that have this project or changing process for the public by involving them in the social
Participant N	User acceptance depending on influencing factors like social media for example ward of the mouth people when they talk in a meeting and so on about the new technology new tools and so on people open towards to the new technologies' privacy
Participant P	I think depends on type of technology, so if the technology is to personal to them, I think the culture and characteristics in this region is privacy is the most important and how safely your information kept look for mobile technology
Participant Q	Dubai has different nationals, each nation has different characteristics, I think it's very hard to limit them, but I'll say that social media influence all nationalities here. We have a lot of technology in here in Dubai we use them all everywhere, we have E-government that used one identity to control all governments' services which I think this will raise the technology awareness among the people
Participant R	I think mostly is the media.

The answers to this question confirm those elicited by the main question; social media is an important means of influencing individuals in GCC countries. Participant L stated, *"I think that social media is the most powerful things to implement such a character especially here in Saudi*". Participant J stated, "*They get the information from different sources but mostly from friends is number one so pure effect*". This indicates that people can be influenced by others to change their minds about an issue, especially by experts in that area. An awareness program is essential for experts as they are influencing others (Sandhåland *et al.*, 2017; Rubens *et al.*, 2018).

4.2.2.5 CORPORATE SOCIAL RESPONSIBILITY (CSR)

Corporate social responsibility is a term used to indicate the extent to which organisations are exercising responsibility toward society. People, especially in developed countries, are aware of CSR and they support organisations that are more responsive to society (Halkos and Skouloudis, 2016; Jamali *et al.*, 2017; Kudłak *et al.*, 2018). Thus, one of the factors of the Green IT model is CSR. Participants were asked whether their organisation had adopted any of the social responsibility concepts, and the reason for this adoption. The question for the CSR factor is "*Organizations that want to appear as socially responsible need to consider four types of responsibilities: economic, legal, ethical, and philanthropic. Does your organisation adopt any of these responsibilities in any strategy? If so, why and if not, why not?*". The question produced various answers as shown in Table 37.

Table 37 Participants' responses to the CSR question

Participant	Answers
Participant A	we are only helping poor people to find houses and paid the first year for free and we try to find a job to them
Participant B	We only send money to a charity organization. That's all that we do
Participant C	Yes, we have are very good programs adopted by our company for people in needs
Participant D	No still needs big investments to help other people
Participant E	Actually, we adopted all of them, we have an ethical and legal economic plan that not clash with people needs in Oman this business always give positive reputation to our company also every year we donated to build new schools in Oman.
Participant F	Yes, we built many common areas in Muscat to be used for public and we help our government to operate The Royal hospital.
Participant G	Well, unfortunately, we do not do any of these components Most company here not responsible about the community unless they forced to do so by Qatar government.
Participant H	I think we do philanthropic responsibilities by giving disability non-profits association some part of our return. This will reflect will to our company name between customers.

Participant I	For the responsible social SASO is playing a big role in the core business for example awareness about the product that not compatible with SASO standard we are aware about the services that we have provided we aware people about the dangers of some products this kind of social responsibility that we provide from SASO
Participant J	Yes, actually I work in the company that involves in energy management without mentioning names so all these four components they are the top priority for us we always market ourselves the energy management and the sustainability leader in the market so all these factors are important for us
Participant K	Actually, it is economically applied, once we have applied all the systems first it is costing the development of the system but later will be safe the cost, by saving all the papers work and saving the plant this is the characteristics that applied in an organisation.
Participant L	Yes, they do anything in our organisation have to go on all these processes specially for a private company so any economic dropdown will be a factor to keep away also legally because the company is care about their reputation ethically we have a very high standards and very high maturity company a lot of postgrad and undergrad with high degrees with high experience in many technologies in different fields.
Participant M	Well in the ministry of Education we have a lot of responsibility that must contain all element that you just said so like having scholarship for more than 150000 students all over the world and having more love than 30000 schools and so the ministry itself is focusing on big picture and increasing its assets toward the government Direction, and definitely all the services are free and also the government sectors have the same thing, the government is paying for the public
Participant N	Actually, our organisation it's just now working with consulting to draw a strategy for them they didn't use to have a strategic mentality and strategic thinking so they were working right now toward strategic goals strategic plans and so on so I would say not mature enough towards thinking about these factors.
Participant P	Yes, we do of course from social responsibility we do philanthropic activity and trying to help and be part of the society as much as we can for example we had never goes that come to us sometimes to help the society to be part of our

	ecosystem that be promoted and start we invest and sometimes they want to take an active part so the approaches us
Participant Q	Yes, we have a deal with Emirates Wildlife society, we are supporting this society by giving them funds, places and other things. We believe supporting such organisations will reflect well to our reputation first and our environment and hopefully most of the organisations are following same our plan
Participant R	In my organisation I think we do all of them the four components I think we should all organisation adopted this component in somewhere, so I think it is a given

Participants' answers indicated some very different opinions, especially in the way they responded to the community. Participant Q stated, "We *have a deal with Emirates Wildlife Society. We support this society by giving them funds places and other things*". This type of responsibility is sustainable and will help non-profit organisations to raise funds for sustainability practices.

Participant M stated, "*in the ministry of Education we have a lot of responsibility that must contain all elements that you just said so like having scholarship for more than 150000 students all over the world and having more love than 30000 school"*, and he added "*definitely all the services are free".* This is a good example of environmental responsibility as well as serving the education sectors. Therefore, corporate social responsibility is applied in some areas and is supported by the GCC governments; however, there are no regulations to force organisations to apply CSR in their operations, and people are not fully aware of the concept.

4.2.3 Information Technology

Information technology is the main component of the final improved model, since this research focuses on technology. GCC countries have been using very advanced technology in their organisations in recent years as part of their development plans, in both private sectors and government-based organisations. "The GCC is one of the fastest-growing regions in the world due to large hydrocarbon resources, strong performance in oil-based exports and efforts by governments to diversify the economy" (KPMG, 2012). Therefore, this part of the research aims to ask specific questions for the participants to confirm the findings from the literature. This section has seven main factors; some of these factors have a sub-factor and appear as secondary questions shown in Figure **37** as a node tree.

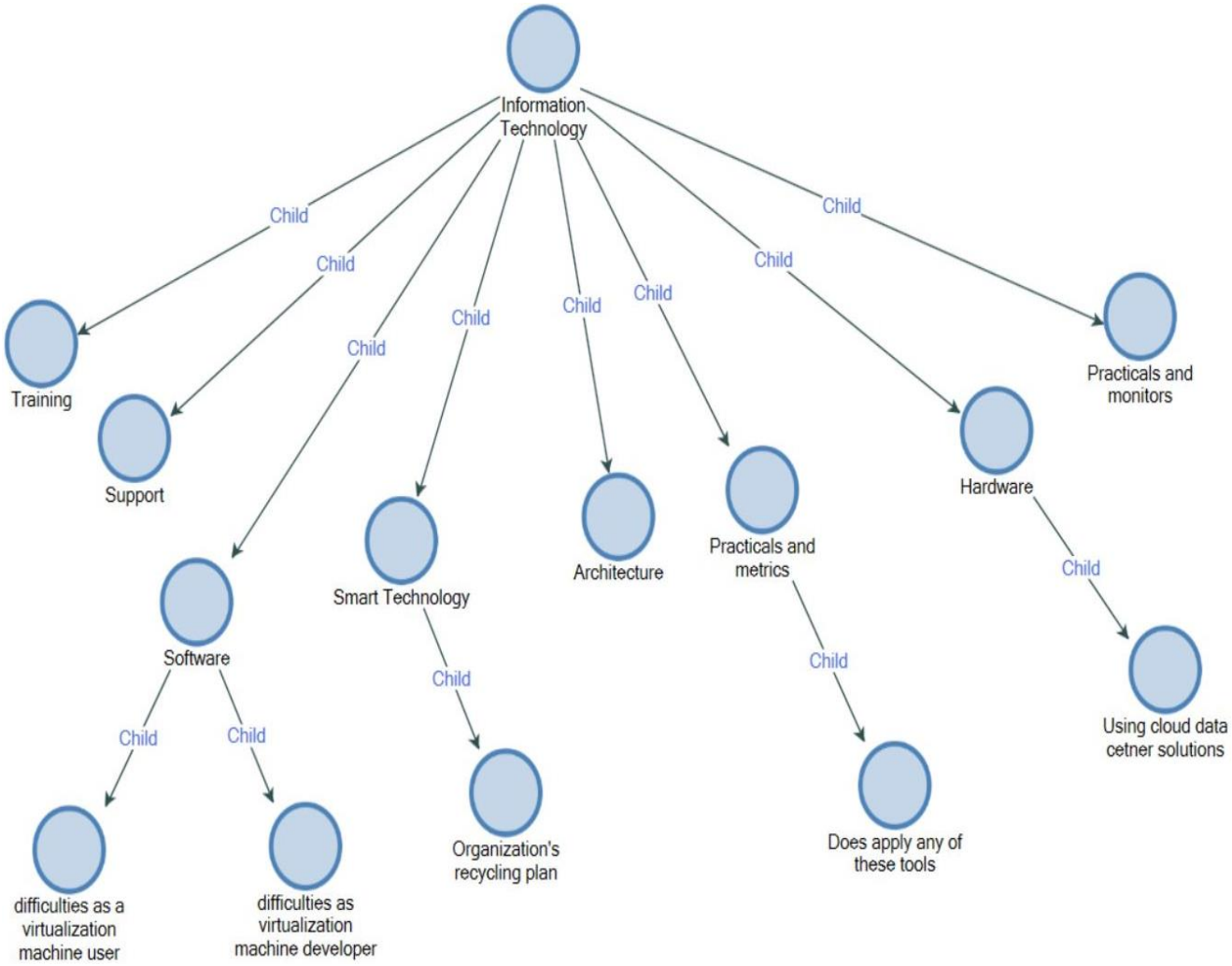

Figure 37**. Information Technology factors branches – developed by the researcher**

4.2.3.1 Smart Technology

The smart technology factor aimed to discover the technologies that are being used in GCC businesses. The term 'smart technology' will include any current or future technologies that will be used in these organisations such as Web 3.0 and mobility communication applications. The question for related to smart technology will measure how advanced technology operations are in GCC organisations. The smart technology question is very important to give a brief but clear idea about organisations' technologies that could reduce the implementation time required for the Green IT model. "If designers manage to work very closely with the users to produce new smart technology or portable devices, then less time will be required in the implementation, testing and training stages" (Issa and Isaias, 2015). The question is "What type of smart technology such as smartphones, tablets and wearable devices are used in your business?". The participants' responses to this question are shown in Table 38.

Table 38 Participants' responses to the smart-tech question

Participant	Answers
Participant A	Yes, we are using all of them
Participant B	We are not using any these technologies, might only access to email through my iPhone.
Participant C	Here email is the main application for our work, we could use these devices to access to our email clients
Participant D	We are using a smartphone application to access our system.
Participant E	Well, I think we use all of them, here we have an application that connected to all devices for doing our business.
Participant F	Well, mainly we use web application for doing our business, this application is accessible through all devices that have access to the internet. So, I'll see that we use all these devices in our business.
Participant G	Well, we do not have a specific application that could install on the smart devices, but we have a web application that could accessed through any internet point.
Participant H	We are using a mobile application that could installed on iPhone and IPad.
Participant I	We are using so many devices for the desktop we are providing desktops for and employees they can use it and access to the application and the for some people we provide them a laptop so they can go and sharing if they having a meeting or any emission outside SASO also we provide a smart tablets with the iPad but usually we will buy the laptop from different companies, we have an internal portal that accessible from any smart devices we have another application for HR
Participant J	Technically all of them we are using a lot of technology in our daily work for example video conferencing smartphone laptops and all these things
Participant K	We are using a mobile application we developed our mobile application, so all the users because we are in the ministry of education, we are responsible for users such as student and teachers, and all students can use our mobile application
Participant L	Everything we have smartphones tablet wearable devices even we have more than that we have a very high technology simulators we have airplanes we have a lot of testing equipment a lot of electronics components builders, so we have too many Technologies Fields
Participant M	Well we have different technology that used here in our organisation we have something for web development and mobile application and the tablet application and so we have different Technologies using iOS and Android and having that dot net Web Development, and in each area, we have expertise in a different type of the systems

Participant N	Actually, using mobile applications web-based application we are not yet into the Internet of things wearable devices we are not yet there
Participant P	We use all of them
Participant Q	Now we have a web application, I always finishing my assigned jobs using my iPhone. And this application is accessible for all other devices
Participant R	Actually, we use the most advanced technology by trying always to chase the newest technology in our business I think we are up to dating in this field.

The data shows that emailing clients is the main communication tool as mentioned by most of the participants. Therefore, this finding indicates that organisations in GCC countries at least have a data centre or they use web services through the IT department. Participant F stated, “mainly we use web application for doing our business, this application is accessible through all devices that have access to the internet”. Web applications are considered as one of the sustainable elements of Green IT as they reduce the number of data centres in organisations. Participant L stated, “We have a very high technology simulators we have airplanes we have a lot of testing equipment a lot of electronics components builder so we have too many technologies fields”. Some organisations in GCC countries are using very advanced technology to meet their business needs; these technologies have been developed by companies themselves or imported from foreign companies. Thus, it is difficult to include some Green IT elements at the beginning of the implementation process due to lack of knowledge about these technologies.

Then participants were asked the following question “Does the organisation have a recycling plan for these devices after being used? If yes, why and no why”. The participants’ responses to this question are shown in Table 39.

Table 39 Participants’ responses to the smart-tech sub-question

Participant	Answers
Participant A	No, we don’t have any plan
Participant D	We do not have a recycling plan
Participant E	I don’t think so; we have the storage they dump all our old devices. Still I think people in this company don’t know that they have to do with it
Participant F	I’m not sure about the plan, however in Oman normally we send back our devices to the same brand to get an upgrade, for example, this Samsung muntrie will be sent back to Samsung once we decide to upgrade to better

	monitor. That means Samsung granted that we are long term customer and we will be upgraded for few money
Participant G	No, at all, the just dumb all old devices and bring new devices. I think people here do not care about it as long as priceless.
Participant H	I not sure about the plan they follow here
Participant I	Actually it is not to recycle we are the government when the devices is old and not used we cannot do recycle because there is a government procedure they take the storage from these devices they remove all the data because it is a government data and there is a process to go with this machines not recycling it is a government procedure we don't have a position to do that so when the device is all done that used we cannot do the recycle so we have just to follow the law.
Participant J	I haven't been introduced to one yet but I am guessing definitely we have something like this but so far, I haven't faced any
Participant K	Yes, actually not recycling, they take some of the old computers and they give and fixing these computers because it has some damages, giving it to some poor schools, schools that have not enough budget so sometimes it takes these computers and the devices for these schools to teach children how to use these computers and so on.
Participant L	Yes, we have a very huge plan especially for waste because we are manufacturing a lot of electronics small components we have electricity Control Systems we have simulators we are working in standards UK standards we have ISO we have contingencies plans we have waste material control so we almost green in this thing
Participant M	Well not for this moment but again we have a huge vision for the whole country, and I am pretty sure that we have a plan for that
Participant N	No, we do not produce mobile devices and hardware they are only software and mobile application
Participant P	No, we don't just we never thought about it. If you want to get rid of it just sell it. I don't think that is any company that will take all these devices and cycle it
Participant Q	We do not apply it yet; I think this plan will be alive soon. Hopefully
Participant R	the company they just like dumping all the devices to Africa and they burning it so I know it is very bad practice happening for this but I didn't know what's the plan they will faces but I'm really happy we are not part of this.

Most of the organisations in GCC countries do not have any recycle plan, at least for their devices. Some participants noted that the system they follow is not eco-efficient, and others say they don't have a mechanism for recycling. The Saudi Arabian government has a different

plan for dumping the devices by changing the hard drives and destroying them, and replacing them with new ones to ensure all data has been deleted, and then sending these computers to charity, which technically is not sustainability, but is considered as better than other waste-disposal practices.

Participant I stated, " We are in the government when the devices are old and not used we cannot do recycle, because there is a government procedure they take the storage from these devices they remove all the data because it is a government data and there is a process to go with this machines" and participant L stated, "actually not recycling, they takes some of the old computers and they give and fixing these computers because it has some damages, giving it to some poor schools, schools that have not enough budget". Participant L's response is different from those of other participants which seem to have a recycle plan based on UK standards.

4.2.3.2 Architecture

Companies' computer architecture requirements as defined by Hennessy & Patterson (2011) are "instruction set design, functional organisation, logic design and implementation". Therefore, computer architecture is the way that an application is built so as to fit the organisational needs, either for software or hardware, based on logic design. Thus, different architectures have been introduced to operate the applications. One of these is green architecture, aimed to ensure that the default architecture is sustainable and reduces power consumption. "GreenCloud is an IDC architecture which aims to reduce power consumption by data centres, while at the same time guaranteeing the performance from users' perspective, leveraging live virtual machine migration technology." (Liu *et al.*, 2009). Thus, participants were asked this question: "An important aspect of the use of the IT technical infrastructure is to solve sustainability issues to make sure that the applications themselves in their architecture are Green. Does your organisation use green architecture in their applications, either software or hardware? If yes why and no why!". The participants' responses to this question are shown in Table 40.

Table 40 Participants' responses to the architecture question

Participant	Answers
Participant C	No, we don't have a green architecture here as well
Participant D	No, we are not using it in our system, our system actually is an SAP application that attached with some our own application to it. So, I'm hundred sure about the infrastructure of SAP application

Participant E	No, we don’t use any green architecture here, we only focus on the performance of our architecture.
Participant K	Well we don't have green architecture, but we have our own data centre which is virtualised so people can access on it from anywhere and get all information also they can write and edit their own information in the data centre.
Participant M	Well in the time being we have the enterprise architecture department for their responsibility that having the architecture of the applications and the infrastructure and having the plans for the green environment well in the IT itself we don’t have these plans but in the other hand we building an IT product that definitely reduced amount of paper and reduced people who come to the ministry itself so we might have a plan the green environment for information technology systems later on but on the other hand we are doing something else but in the same direction
Participant N	I will say to be honest no the development department when the develop a software quality assurance when they check the quality of the software they take under consideration and environmental friendly factors also for the hardware the take into the consideration the cost and quality only they care about minimised cost they care about the good quality and efficiency but not about environment friendly is not a factor, I would say because the regulation in Saudi Arabia they're not yet how to let people thinking the environment friendly no taxes even for non-environment friendly products
Participant P	No, we don't the reason because of the requirement in the UAE
Participant Q	We are using Amazon AWS, now we will be no more using our data centre. I think this plan is very helpful to our business and make it better faster and costs less and I just realised it is more environmental as well

The data shows that most of the participants’ organisations have not applied any Green architecture in their operations. Participant M’s organisation has no plans for the adoption of this architecture; however, they try to minimise the amount of paper being used and have digitalised the transactions to reduce the number of physical visits to the organisation. Also, participant Q stated, “We are using Amazon AWS, now we will be no more using our data centre”. This cloud architecture is recommended by various Green organisations since it will minimise the number of servers in a data centre.

4.2.3.3 Hardware

The data centre is one of the most important technology set-ups for any IT department. Also, the data centre, more than any other part of an organisation, is responsible for the largest amount of power consumption. The data centre is always demanding more equipment based

on organisational needs, and any extensions are costly if they are to operate effectively. Normally, extending datacentre is unsustainable, particularly if new equipment is added to the current data centre only to meet immediate demand rather than considering a long-term plan. However, there is a sustainable solution to meet data centre demands at a reasonable price and with high efficiency. “For most CIOs and IT vendors such as Dell, HP, Intel and Sun, Green IT is all about data centre efficiency” (Molla, Cooper and Pittayachawan, 2009). Some of these solutions involve using cloud services and virtualisation. Thus, participants were asked: “Recently IT department operation is costly due to the high demand for storage and network equipment; however, there are alternative ways to reduce this cost i.e. Cloud and virtualisation. How would you overcome the datacentre demand in your organisation?”. The participants’ responses to this question are shown in Table 41.

Table 41 Participants’ responses to the hardware question

Participant	Answers
Participant C	We only extend our data center by purchasing new devices
Participant D	I will call this not an issue, we have an open bill to extend our data center
Participant E	Well, normally we extend our data center to fits our needs, lately we have a very big volume of storage, to honest we have problem with amount storage that we have in our data center, that force us to employ people who experts in Big Data and Data analysis, these people wages are very high.
Participant G	OK I think this is one of our current issue that we always extend our data center these days our employees are using high amount of storage which required high demand of setup and connected to our RAID storage many issues might happen during these installations, we are using a traditional way of installation by extending our data centre
Participant H	In our company we are using a cloud solution, we do not have a data center, all our transaction is done in Amazon AWS.
Participant I	Actually, we start more than 4 years ago to go virtualisation hopefully within the coming days the government put some regulations regarding to the cloud then we can go cloud because now SASO is a government agent we cannot go cloud with our data till getting regulations from the government so hopefully with coming days or month the government put some regulations or procedure just for the government cloud.

	Participant K	Well we planning to upload all data in the data centre to the cloud to be more efficient have the quality of the connections to access the data centre for all users around Saudi because we have all branches even these people when they access it they would use the Internet not the local network, so it will be costly when we just using the local network but when we just move to the cloud services will be much cheaper
	Participant L	We have a lot of hardware servers but that's one for local use and some other local systems like ERP systems but the company are connecting to a cloud system in certain things like file transferring not like a Google Drive and all these things as you know this does not save some time but in our immigration because very huge we are using a virtual servers so once server can do from 6 to 10 another virtual server which will reduce the number of the servers and will reduce the cost for the company
	Participant M	Well the infrastructure side is not my core so I am better in software engineer but my colleagues in the infrastructure team they are walking in reducing the amount of servers for our systems well as you know we have around 30 application either web or mobile application they're having plan in building new data centre with less numbers of servers and more efficient I believe we are going toward this plan
	Participant N	Actually, currently we are using virtualisation we are adapting virtualisation for example for capacity planning and so on however when we talk about cloud we government agency at end and there are other policies and regulations for the government that we do not host our data outside of our data centre so we have to keep them within our data centre and we use a virtualisation
	Participant P	We are using cloud computing and remote working the cost of bringing someone here is high so we do use cloud and virtualisation both our shared drive in the cloud, we do have our Chief legal officer for our content developer one of them in Australia and other one in India so they are virtually engaged in our team every day so we use both.
	Participant R	I don't know we are talking about some subscriptions in some services like cloud services for specific things so yes I'm using online storage, so I don't have the authority to make changes but any costs moved or changed can reflect to better performance something that I think it's great to do

The data shows that most of the participants adopt the usual way of extending the data centre, adding new equipment whenever the business requires extensions. However, other participants are planning to move to cloud or use virtualisation, meaning they do have enough knowledge to change to Green IT and sustainability. Participant K stated, “Well we planning to upload all data in the data centre to the cloud to be more efficient have the quality of the connections to access the data centre”. Participant M stated, “the infrastructure team they are working on reducing the number of servers for our systems well as you know we have around

30 application either the web or mobile application they have plan in building a new data centre with fewer numbers of servers and more efficient".

Therefore, several IT departments in GCC countries are planning to achieve better performance with less power consumption, which is an opportunity to apply Green IT concepts at this stage. Lastly, a move to cloud by government and governmental agency organisations requires approval from the government itself, as the government needs to apply its regulations to this service or build their own private cloud. Participant I stated, "we cannot go cloud with our data till getting regulations from the government". Participant N stated, "about cloud we government agency at the end and there are other policies and regulations for the government that we not host our data outside of our data centre so we have to keep them within our data centre and we use a virtualisation".

Then participants were asked the follow question: "Does your business use cloud data centre solutions, such as Amazon AWS and Microsoft Azure? If yes, why and no why?". The answers to this question are shown in Table 42.

Table 42 Participants' responses to the hardware sub-question

Participant	Answers
Participant B	I'm not sure about that as well.
Participant C	No, we are not using these services, we have our own data center, I think it is cover or needs
Participant D	We are using Microsoft Azure in our website, but we are not using as the main web application.
Participant E	No, we have our data center and we connected through internet to use our services.
Participant F	Yes, we are using Amazon AWS in our system. Amazon AWS offers good performance with a reasonable cost for our organization also Amazon has amazing support that really hard to find these days such a support.
Participant G	No, we are using our own data center, our data is very sensitive, uploading our data in could is risky and might we lose our business if some hake it.
Participant I	No actually we don't use it the government till now they don't but the procedure the regulation regarding to this services, because the government ask they should put the data in their own data centre within current month or maybe one year the government the will put some

	regulations to provide some services through the cloud, if we go cloud we have to put some data not in our own storage since this data is a sentence data.
Participant L	No, we didn't use it because we didn't need it as I mentioned before sometimes file systems like Google Drive for just document controller but still for us not 100% efficient so we use our virtual servers
Participant M	Well in Saudi, in general, all government sector not allowed to have their all information in the public cloud but we have as Saudi government we have a plan to build our own cloud it will be national cloud and I don't know other countries they did that before but this is a huge project at time being
Participant N	No because we are a government organisation as I said before we're not allowed to do however other companies and organisation that allowed to use such services they use them for example my colleagues he works in private sector company they use Google mail servers they didn't use exchange
Participant Q	It's true that equipment was costly and always we extend it.
Participant R	I think yes, we are using Amazon AWS, most of the people they are working in web apps they are using Amazon AWS I think it's very cheap and good performance.

The data shows that most of the IT departments are using part of the commercialised cloud solution, for website purposes with no sensitive data. However, these services cannot be used by government organisations without first being approved and regulated. Participants who use the cloud services are pleased with the price and the performance. Lastly, in regard to the best solution for government organisations in GCC countries, there is the need to ensure that the regulations for the private cloud take into consideration the Green IT elements.

4.2.3.4 Software

One of the Green IT solutions is to use optimal software that reduces the power consumption at the same time as giving better performance. Software like a virtual machine either for computing or servers is just an example of how Green IT is capable of handling the performance. Using a cloud platform and virtualisation should improve energy efficiency and reduce costs and hardware (Ardito and Morisio, 2014). Therefore, participants were asked the following question "Virtualization is attached to entire computer architecture in software which provides the virtuality of a real machine including all software running on it. Do you have a virtualization machine installed in your organizations? If yes why and no why". The answers to this question are shown in Table 43.

Table 43 participants responses to the software question

Participant	Answers
Participant B	Yes, we have virtualisation installed on all systems here, I think is very nice tools that help me to organise all my files in one place
Participant C	No, we have a standalone PCs for each employee
Participant D	Yes, we have virtualisation machine installed, I think the most important thing in virtualisation from me is easy to make changes and maintain the system
Participant E	Yes, we have virtualisation machine installed to all computers here to simplify our work and we could reach all files from one space also to ensure high performance and much cheaper licences as we purchase it as a package.
Participant F	Yes, we use virtualisation on in the ministry. Off course virtualisation has better performance and can make all file are available anytime and anywhere, sometimes when I at my house I access to my file to finalise my work
Participant G	Yes, we are using VM ware installed on all computer that connected to servers, I think virtualisation is very secure as our business mainly focus on data security, so we have all data located in one place, we know how deal with data, almost zero dirty data in our system.
Participant I	Yes, we moved from physical servers to virtual servers starting from 2012 when we bought a new servers it easy to go virtualized because all the technology now goes virtualizations instead of physical servers and this virtual machine will reduce the cost of the power we will reduce the cost of the storage also will reduce the cost of management in general, and we'll get same or better performance
Participant K	I worked previously entity that is the best of virtual machines, so I like it. Which I have previous experience in a virtual machine.
Participant L	Yes, as I said before we do have a lot of virtual servers and visual systems IT department in a tiny office but they monitor a huge factory area and they say but a lot of computers and other systems networking infrastructure REP systems all these things you know some software testing all connected to a virtual server, and still the company want to reduce that extra cost
Participant M	Yes, we have some virtual machines I think a different type of application is using that but again this is not my core
Participant N	Yes, we have I think VMware, they adapted it for is your management they can manage that tools easier they can also save cost and been more efficient more flexible there are more benefits to use virtualisation but none of them used as environmentally friendly

According to several participants, their organisations have already installed virtualisations

either locally or at the server level. Participants whose organisations had installed virtualisation found that it offers better performance with more reliability and gives more control to all computers. Participant E, stated, “here to simplify our work and we could reach all files from one space also to ensure high performance and much cheaper licences as we purchase it as a package”. Participant I stated, “because all the technology now goes virtualisations instead of physical servers and this virtual machine will reduce the cost of the power, we will reduce the cost of the storage also will reduce the cost of management in general and we'll get same or better performance”.

Then participants were asked the following question: “As a virtualisation machine user, what are difficulties that faced during normal work?”. Participants’ responses to this question are shown in Table 44.

Table 44 Participants’ responses to the software sub-question

Participant	Answers
Participant B	I don’t have any issues, might bite slowly in the login, but I think not issue.
Participant D	Sometimes we have to do our monthly maintenance, we need to shut down all computers
Participant E	We don’t have any difficulties at all. Very useful from my sight,
Participant F	I’ll not say difficulties, just normal expectation for all users of virtualisation such delay in the begging of login, some application takes while to run since needs to retrieve some information from the server
Participant G	No, I do not had difficulties, very easy to use with plus punch of services.
Participant I	The difficulties is related to find high skilled people they can do virtually because it is kind of Technology that need a high skills people be able to do the configurations management inflation configurations sometimes when we have an issue with a virtual all issue would have a train station we need to hire a good high skilled people try to fix it
Participant K	Actually, I didn't face any difficulty, but sometimes if there is no connection, or even have bad connection it is not easy to retrieve all data, that's might only difficulty we have, otherwise it's perfect.
Participant L	Sometimes in the heavy load of the users or any error or any downtown of the machines, we will be disconnecting just certain files and sometimes this is lot printable or printed so once that not around, so this is difficult for us to implement any information

Participant M	Well I didn't know that will be good as the normal standard usage of other applications but using the virtual machine have advantages and disadvantages for my opinion, I think at end of the day it is pretty good specs for our application
Participant N	I don't see any difficulties I see the positive side I see benefits not difficulties

Participants stated that they generally have no difficulties in using a virtual machine in their organisation. Participant I mentioned difficulties in finding highly skilled people who can resolve any issues at the beginning of the installation process. Participant D stated, “Sometimes in the heavy load of the users or any error or any downtown of the machines we will be disconnecting just certain files”. This considered to be one of the disadvantages of using virtual machines, and to overcome this issue, the IT team needs to be trained very well to quickly resolve any issues.

Participants were then asked the following question: “As a virtualisation machine developer what expected technical issues and management difficulties do you expect to face during the installation process? How you will manage to overcome these issues?”. The answers to this question are shown in Table 45.

Table 45 Participants’ responses to the second software sub-question

	Answers
Participant D	Off course there were difficulties, people they not using it in the begging some computer not ready for the virtualisation machine some systems give high CPU processing we have to take care about all these issues.
Participant F	I was here during the installation, people they are refuse it in the begging accounts that all the file on the computer, we gave them one month to move all necessaries files to a personal hard drive. Another problem that we have to stop all computers during the installation VM, that means at least two working days from all worker will not accounts. We decided as the IT department team to make this installation on the weekend, we worked a very long weekend, we end up with very successful installation
Participant I	I think it is already did about the skills if you have a high skilled people you will be overcome this issue and we have to also pay the licence for the virtualization we have to get training from the virtual company for example VMware or Microsoft then we have to educate the people we have to train them do that and they will get day by day the experience to overcome this issue

Participant N	Actually, I didn't see issues some, of the issues for example if you need to upgrade or maintain a specific server within this rack or this tree it will be hard but I don't see issues it is much better than classic data centre architecture much better

Participants who had installed a virtualisation machine faced various difficulties during the installation process. Participant D mentioned different issues such as the end-user not being familiar with the new system and therefore not using it. Technical issues included computers not being compatible with the virtual machine. Participant I mention that, the most important thing is hiring highly-skilled people who are capable of driving the installation process smoothly. Also, when obtaining the licence for the virtual machine, it might be difficult to decide which one is appropriate for the company's needs.

4.2.3.5 Practical

Green IT practices is one of the tools that helps organisations to receive real-time data updates to the system. There are different tools available in the market, and many companies are offering these tools for a reasonable price compared with the long-term returns. Unfortunately, the lack of knowledge about these tools is the main issue and many IT personnel do not have enough know-how to apply these tools in their systems. Green metrics is one of the practices for sustainability and quality (Naumann *et al.*, 2011). The researcher has divided the practical factor into two technical sub-factors: metrics and monitoring. Monitoring is a green tool that can monitor environmental performance to ensure that all metrics applications are used properly.

4.2.3.5.1 Metrics

Metrics concerns software tools that collect or analyse or model and produce an energy report to be used in a Green IT practices plan. Participants were asked the following question "Green metrics is a software tool for collecting or simulating, analysing, modelling, reporting energy consumptions, environmental risk management, environmental impact, and greenhouse gas emissions". Do you think these metrics tools will be useful for your organisations?" The responses to this question are shown in Table 45.

Table 46 Participants" responses to the metrics question

Participant	Answers
Participant D	Yes, tools make my life much easier
Participant E	Here we have a team that aims to analyse all data that in our data center they are using various tools that help them to rise the data center performance.
Participant F	Yes, regardless that is environmentally will be powerful to run our business with more numbers that could we see our direction.
Participant G	For sure here we cannot make a decision unless we have enough number to see the complete picture even Green IT model, we have to see numbers that make the Green IT model clear to know how will useful for our system
Participant H	I think yes, an analysis tool is very important to know about your work rate something you have to make a decision based on these tools.
Participant I	Yes, actually this kind of metrics is very useful for any organisation because it is give you the information about the power you need the power consumption when you add some servers when you add some cabinet if you have this with server will be easier the installation and it will reduce any risk in the future
Participant J	Well of course I'm working in a company that not only use these applications but also develop and sales these applications and we proudly we have one of the first Green Building have ISO 900001 certified buildings as a Green building in Saudi Arabia so yes, it is used for that for us for the whole planet I guess
Participant K	Of course, yes, we use it the employees in the ministry of the education is more than half million because we have all the teachers around Saudi so by letting the computer sleeps it will be saved the power.
Participant M	Well we are not using any of that right now as I said we have Saudi vision for 2030 and we have a lot of new initiatives and I believe it will be a focus on same area
Participant P	no policy in a place to put this, if it is my company I would like to apply this to look good in my report to look good when I interactive with other investors or I am approaching with other corporate and be very useful thing to show them how we advanced in term of how we take care about our employees and take care in the client needs and also take care in the environment it is amazing thing to do but it is not something that's my call.
Participant Q	Yes, of course, but similar to the phone notification, these tools wake you up and give you attention to reduce your usage. And also, I think organisations needs at least power management which is very useful to reduce the power usage

The data shows that several participants are already using metrics in their data centre applications. For instance, participant I uses metrics for power consumption and capacity reading for the cabinet in the server's racks to receive real-time information to decide whether the data centre needs to install new equipment. This way of using matrix consider as sustainable if the new extension is environmentally friendly. Participant J is working in a company that develop metrics for other organisations, and this company has a green building certification according to ISO 900001 standards.

Participant P's organisation does not have such a matrix because no policy has forced them to do so; therefore, increasing awareness of these metrics will increase the opportunity to create policies that suit GCC organisations. Then participants were asked the following question: "Does your organization apply any of these tools? How these tools reflected to your work? Tools such as power monitoring, calculate CO2 usage and power management calculator", the answers to this question shown in Table 47.

Table 47 Participants' responses to the metrics sub-question

Participant	Answers
Participant C	No, we are not applying any of these tools here
Participant D	Yes, we power management calculator installed on all computers, I think is very useful to save power
Participant F	Yes, we are using a reporting energy consumptions and environmental risk management, people can see how they consume during they doing work and we could focus on power management as well.
Participant H	We are using Amazon AWS, because is available and very convenient, also amazon known as one of the top companies in security.
Participant I	actually would last a project to maintaining the data centre we get full access from Schneider this kind of system from Schneider is very smart to get all the tools not just for one cabinet for all cabinets it will give you the humidity, the power heating, for all the cabinets not just want cabinet this kind of system it will help you too to know exactly where the consumption of the power and CO2
Participant J	Well they have affected because everywhere I go in my office active tools and these numbers there are fluctuating all the time actually created some sort of awareness for me then I know things about CO2 emissions and the power management and all these things
Participant K	Yes, actually it applied in the computer itself so once we do the installation it's one of the rules for the IT department is letting the computer do sleep and do the power management calculator for reducing the power.

Participant M	We are using power management calculator I think that PI some sort of applications that shows us a lot of reports that we can have some decisions based on that
Participant Q	Yes, we have analysis tools, and we have power management as well. I think to work very well and make me organize my work much better

A number of the participants are using metrics in their organisations, and each one of them is using it in the way that matches their needs. Using cloud solutions such as Amazon AWS, already has its metrics as a package, which makes it very convenient for the customers. Participant H stated, “We are using Amazon AWS, because is available and very convenient, also Amazon known as one of the top companies in security”. Most of the participants are using these metrics for power management and calculating the CO_2. Participant I use metrics to receive information about the data centre cabinet in terms of humidity and power used for heating. This tool will help to obtain more accurate data about the areas that are consuming the power.

The monitoring tool is green in that it monitors environmental performance to ensure that all metrics applications are used properly.

4.2.3.5.2 Monitors

The monitoring sub-factor comes under the practical application factor and aims to ensure that Green IT software in an organisation is working properly. In addition, monitoring is helping the business process of an organisation by ensuring the new green model performs the same as before or better. Monitoring the system enables the evaluation of the performance, monitoring the activities and taking control actions (Issa and Isaias, 2015). The participants were asked the following question: “In terms of environmental performance, information technology in the technical infrastructure could increase the efficiency of environmental management processes by analysing, monitoring and streamlining business processes. Do you think mentoring the environmental performance will be reflecting well to the organisation business? How?”. The participants’ responses to this question are shown in Table 48.

Table 48 Participants’ responses to the monitor question

Participant	Answers
Participant A	I don’t think so
Participant C	Yes, mentoring will minimise the usage of our server and computers

Participant D	Yes, I think so, I personally using cloud application
Participant E	I don't think so it's pretty hard to know what environmental performance is and how to increase it in our organisation, people might confuse between normal performance and environmental performance.
Participant F	Off course yes, any analytic tools that are given numbers is perfect for any business decision.
Participant G	It depends, if the new system does not harm our data, or has less requirement in term of security, we will not be useful to our system, we are focus on the data protection, which means any solution not accepted from the mother company will not be applied to our system
Participant I	I think monitoring the environmental performance is very important but you have many options to do that maybe baby born or by the System you can implement and will give you the notifications if you have an issue with the power the heating the humidity this kind of system
Participant J	Of course, I mean reflecting the way we do our business it gives us an image of a company that cares about the environment and facilitated some of our business processes weather we are pending a project with the government or private sector and will give us an advantage over other company that do not preach on these value
Participant K	Alright we give training we give our own session as I said before we have a direct and indirect way for the training and awareness
Participant M	Definitely it will be a great idea for measurement that to make sure that we are going in the right direction
Participant P	Definitely will be reflected well to our organisation business, but who, I wouldn't know because we have nowhere way knowing within my company I mean we actively invest but how we going to develop these kinds of metrics especially through Internet of things technology so I wouldn't know could this would be beneficial our company but I could not tell you how will be not beneficial in Dubai because we didn't need this.
Participant Q	Still we are not on the point on our business, and It is hard from me analysing these concepts right now
Participant R	Yes, definitely I think like will reflect well to the organisation business I think the green concept itself as I understand it been designed to be better business firstly and it is obvious for me it has better business for everybody.

Monitoring is a very efficient method according to several participants. The data shows that participants are pleased with the result of monitoring the performance. Participant F mentions that the analytics tool is a part of the monitoring tool that is very useful for business decisions. This is a very useful finding since, recently, the IT department has become the most important

most important department in most business organisations. Therefore, decisions from the IT department are taken seriously, because any poor decision will be costly for the organisation, and the monitoring tool will help them to make better decisions. Participant J stated, “I mean reflecting the way we do our business it gives us an image of a company that cares about the environment and facilitated”, which mean the results of monitoring the performance indicate the extent to which the company cares about the environment.

4.2.3.6 Training

Each organisation has different ways of improving its employees’ skills and matching these to the organisational needs. In general, training provided by organisations can change the employees’ attitude, which might reflect on the employees' personal lives. Saving the environment is a human value, which needs to be taken on board by the developing nations. “Organizations must offer training programs to employees for familiarising the new environmental policies and restrictions” (Chou & Chou 2012, 449). Therefore, the training factor investigates whether the training offered by organisations in GCC countries is changing the individual's attitude. Participants were asked the following question: “The best way to change current attitudes of organisations’ staff is give them education and training. What is the followed system in your organisations in order to change individuals’ attitudes?”. The answers to this question are shown in Table 49.

Table 49 Participants’ responses to the training question

Participant	Answers
Participant A	We paid to each employee once a month one session
Participant B	We have a big library that has classes free to book by any employee, these classes have a projector and setting. Also, we have a meeting room for brainstorming and discussion.
Participant C	We have training session weekly and we are inviting trainers to train our employees about sorting topics that we need to use it in our company
Participant D	We have a training room available for anyone who wants to do a training class
Participant E	We have an agreement with a company who specialised in training, we have only given them scrip of our aim and they organise the training session with time and place, all we have to do just announce the training details to our employees.

Participant F	here we follow a training plan from an Indian company called InfoSys; the plan is quite interesting, first we have to train the end uses about how to use the new system, then we make the end-user train the top management people to show them how the end user understood the new system and gave them confidence that end-user ready to use the system.
Participant G	Well, we have many tools that we could apply it, first we have a common area in our company that we could discuss many topics, all our employees have ability to open new training session and invite other employees to attends, this will be very useful to change people attitudes
Participant I	I think it is all about training it is about education and the awareness, actually do you link each year we have a development plan for each one and training plan for each one any IT stuff from December starting plan for their development during the next coming year part from this training sometimes that's related to professional skills sometimes related to behaviour skills also for IT we do so many awareness not just for the IT for SASO stuff related to Information Security
Participant J	Well usually we have many trainings actually they are promoting ideas of sustainability and Green mentality so in a year we could have more than 5 training related to subject that seminar or physical training
Participant K	Alright we give training we give our own session as I said before we have a direct and indirect way for the training and awareness
Participant L	The cultural program as I mentioned before if the company apply for that cultural program everywhere in the company they started from the top management follow down to to the bottom of the company soap once you change the mentality of top management you can change most of the company's cultural
Participant M	Will definitely having courses in this area will change but I think from my opinion having the cultural change is the first step for changing all the experience and the resources and our colleagues here in the IT department and other departments in this ministry
Participant N	Actually, we do follow training awareness for example emails and documents for awareness and also training but training only for to fill a business need only
Participant P	I think the best way to change current attitude is providing education and training we don't follow any system at this moment because there is no requirement, but we profile books for employees title like what is the best practices to have a friendly office, we do have a lot of books and in our small library, but I wouldn't know if will be counted as organisational attempt to raise the awareness on this is specific topic green IT and I think it's exist because so many people in different company they used to do it.

Participant Q	We support our employees to registering on online training and take a course in MOOCs like coursera and edx, some MOOCs is a paid service, and we will take care about the price if this course related to the employee's job.
Participant R	I think it is the education more than others in my organisation we have an environment that we can learn a lot from like reading the most recent books and articles something like in encourage our environment to be around colleagues and I see it making different.

The data shows that there are various ways to train employees in GCC countries. Participant A's organisation pays for monthly training sessions for each employee. This gives the employees more flexibility to choose courses that match their needs. Participant L stated that they have a cultural program in all departments of the organisation for all management levels, which is very useful for changing employees' attitudes. Participant P states that his organisation offers education sessions that are accessible to all employees. The education environment has a library, and training sessions delivering an awareness program. Participant I stated that his organisation offers a different type of training: in December of each year, all employees are asked to submit a training plan for the following year, and the respective departments approve the plan if it matches the employees' needs.

4.2.3.7 Support

Support is the final factor for the IT section and relates to the maintenance of Green IT systems. There are different ways of supporting the system that has been installed in any organisation. IT support has to be operated by the IT department; therefore, they must have a very solid support plan to minimise the number of issues after the installation process. "Technological and relationship resources impact on the functional capabilities of IT departments, which in turn impacts on the capability of IT to support the core competencies of an organisation" (Molla et al. 2009, 2). Participants were asked whether support will be useful for maintaining their system. The question that was asked is "Providing analytical tools and IT support for businesses that targeted to reduce CO2 emission will ensure both direct and indirect success of implementation. Do you think that "support" is one of the critical aspects to maintain the new system? How? If yes why and if no, why?". The responses are shown in Table 50.

Table 50 Participants' responses to the support question

Participant	Answers
Participant A	Yes, support will make sure that system will alive for a long time
Participant E	Yes, I think support is the key to any successful implementation, support is most important to give the end-user the confident about the new system. Here we focus on support by using online ticket system to ensure all support tickets are solved.
Participant F	training and support important not seeing in the begging; however, we could see its important in long term practicals; for example, if you see any application such as a computer or phone application that has very good supports, means this application will on the market for long term.
Participant I	Yes, actually the support it is one of the critical aspects when we have an analytical tool because as you know if we share this knowledge with our team and if they can provide the training and the knowledge the whole team will aware this kind of analytical to use to make sure the new technology will go green
Participant J	I think so but is a very critical and especially in the beginning it is a natural thing to have and support at the beginning because we are adopting a new system so we will have many questions to be answered and support will help us to get along with the new system
Participant K	So, we have an analytical tool that calculates how many papers that we are saved also the tool itself count how many trees we saved since I think we reduced around 30000 paper so this tool can count and tell us how we saved the planet. So, I agree with that.
Participant L	Yes of course if someone Take the Lead especially from the management if he takes the lead to make that program or that project to succeed he will we find the way to apply it so support is very important I mean supposed to come from every part of the organisation but once you bring it to the top of the organisation the flowing of that one will be very easy
Participant M	Definitely having different type of stuff and groups for support for the implementation itself is a great idea and I think lamentation team should focus on the implementation later on they will have much experience about related to business for the ministry of education and so on so we have the ability to support later on so I think they will be upper hand for supporting the system
Participant P	Yes, it is I think usually after training people of might change between 6 to 7.
Participant Q	I think so, Support will ensure a successful implementation by help users to overcome installing issues, as you know implementation issues need to be covered directly to avoid slowness in the business process.

Participant R	From 0 to 10 I can see about 3 to 4 sometimes 5 but I see something else sometimes when we are putting these courses the performance will increase may be from 7 to 8 maybe sometimes the adaptation will take some time not going to be easy like putting these courses I think it's going to make big different

Most of the participants agreed that support is critical to the maintenance of their systems. The data shows that participants use support and awareness programs at the same time, to ensure that all employees are aware of the new system. Participant K stated that they support sustainability by using an analytic tool to show to the employees how many trees have been felled for paper production. Since they installed the analytic awareness tool, they produce 30000 sheets. Participant M stated that they make sure the IT team who installs the new system also provides support for this system. This method will minimise the time needed to resolve problems since the team has knowledge about the new system from the installation process.

4.2.4 Green Management

The green management section is used to investigate whether the new Green IT model that has been applied to an organisation will be continuously run in the long term. Therefore, the green management section has three factors: E-waste, economy and environment. E-waste factor is the ability to environmentally manage the waste all the technologies that used in an organisation by following a plan that matches the Green IT efforts. “The need to operate IT equipment results in huge power consumption increased carbon emissions and massive e-waste generation consequently causing serious health problems to human life” (Khan et al. 2014, 9). The environmental factor aims to manage the new model environmentally, which considers the environment with each purchase, especially any purchases by the IT department. The economic factor is included to ensure that the new model does not negatively impact on the business process or prevent the business from running better way. For instance, sending email messages to clients instead of paper communications is cheaper and better for the environment. Figure 38 shows the branches of the Green Management factors.

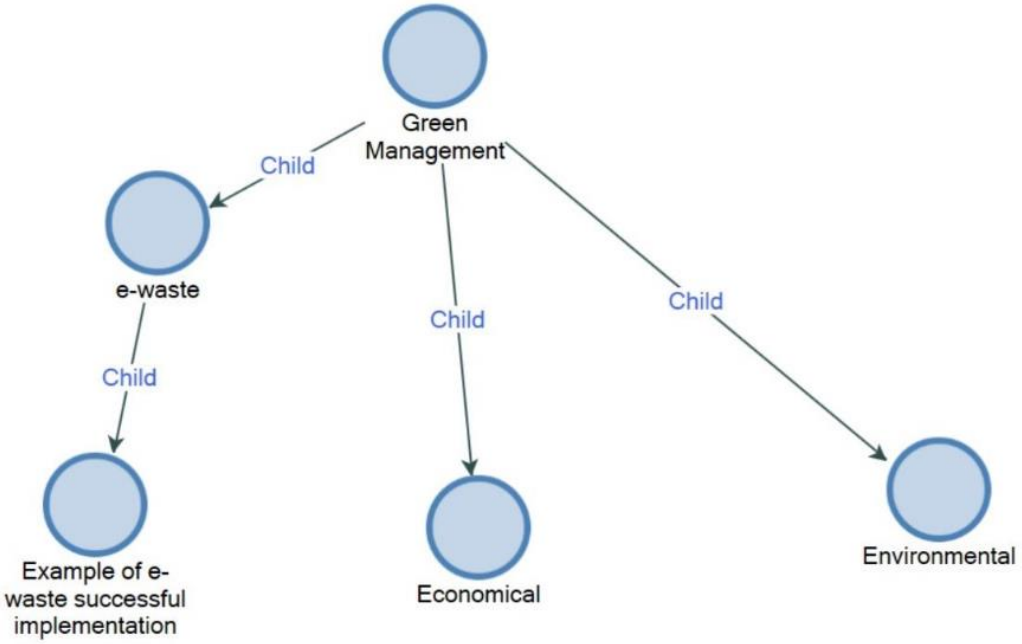

Figure 38. Green management factors' branches -developed by the researcher

4.2.4.1 E-waste

E-waste is part of the sustainability practice that requires maintaining the new system to run under Green IT concepts. The most well-known IT companies have an e-waste plan, especially in the developed countries, as a part of corporate social responsibility. Each company applies an e-waste plan, and there are a number of plans that safeguard the environment. "Developing countries are highly concerned by e-waste problem and that Green-IT offers opportunities and allows for economic, social and environmental benefits." (Hanne 2011, 426).

Therefore, the e-waste factor investigates whether participants in GCC countries are aware of E-waste, and how that will affect the IT performance. Also, participants were asked whether there is a successful e-waste story in their organisation. The question is: "A recent research shows these hypothesised; Firstly e-wastage disposal has a positive effect on global warming. Secondly performance of eco-friendly IT products has a positive connection to e-wastage disposals. Do you think that applying e-waste to organisations will increase IT performance? If yes why, and if no why". The answers to this question are shown in Table 51.

Table 51 Participants' responses to the E-waste question

Participant	*Answers*
Participant C	I'm sure about this hypothesise, but I know that e-waste always reflecting well to performance because minimise the transactions that sent to the CPU
Participant D	Yes, we have here a lot of devices that not used for years,
Participant E	Yes, here we have various old storage devices on the data center which means these storages will decrease the performance since its technologies are old the best way I think we have to recycle the old devices and bring better devices with new technologies to increase the performance.
Participant I	Yes, actually when we apply for e-waste applications it will increase the performance because we have so many servers will go fast and we will go with the new technology for example virtualisation so I think yes that E-waste will affect the performance either from the hardware maybe we can do upgrading or just to increase and spare part it will go better with the new performance
Participant J	Yes of course it will affect because when you go for E-waste your recycling and then you don't repeat the initial cost the initial investment again and again you will walk in the initial investment and improve it and you will get better results financially and performance in your equipment
Participant L	Yes, I think I believe if you put pressure on more rules in your regulation which will make people do more effort more than they were supposed to do they will try to avoid it as much as they can so if you implementing a policy
Participant M	Definitely E-waste is the new direction for IT in Saudi so we have a lot of applications and databases that having something that should we clean so we have data cleansing project that will reduce the rubbish date that we have and I think having a great application how we can make sure that data should be inserted cleaned in the first
Participant N	I think it will have a positive value to our organisation however adapting e-waste and other advanced concepts I think it will be must be regulated by the government and need time to reach mature level
Participant P	Theoretically yes but I wouldn't know this does not apply to my business, however providing analytic tools is essentially require to know the cost benefits of the cost analysis at end of the day so if I have this analysis tool and I know for the fact the success of applying this to my analysis to shows that I can increment this so I will spend money on this.

Participants are familiar with the e-waste concept, and most of them agree that this will reflect

well on their organisation. Additionally, some participants were already applying the e-waste concepts in their organisation, and they have a success story of this implementation. Participant M stated that they do have e-waste at the software level to make sure that unnecessary data is deleted to save storage space. This method is useful for a short time; however, it is not sustainable. Participant N agrees that responsible e-waste disposal will be positive for the organisation; however, to reach the mature level, the government has to apply regulations for e-waste. Participant I stated, “when we apply for e-waste applications it will increase the performance because we have so many servers will go fast, and we will go with the new technology for example virtualisation, so I think yes”.

Then participants were asked to “please provide some example of successful e-waste implementation in your organisation.” The responses to this question are shown in Table 52.

Table 52 Participants’ responses to the E-waste sub-question

Participant	Answers
Participant I	Yes virtualisation is one of the example implementations of the e-waste also when we have old machine for example desktop or laptop and we need to do up upgrade for the memory all the hard disc or the processes we take consider of the e-waste to make sure we reuse this machine not just remove it from the services
Participant J	Well I remember recently we there was an advertisement for an auction on products that come from IT also the facility department so this one of the examples we don’t waste our products
Participant K	we give the old computer to the poor schools to help teachers and students to use and learn the computer
Participant L	We have rules to shred all papers so the papers have to go e-waste it is not a policy but once you print a lot of in the office it will be not likeable so always try to avoid printing unless in case official letters
Participant M	Sure we have a project for scholarships students actually we have a students are in all over the world so we have 34 culture missions they are having system for each a cultural mission so we have done a SAFEER web application that make all cultural mission all over the world using a single platform so when we have this new system we have a huge data migration from old systems to this single new platform during the data migration there was data cleansing process which has a lot of e-waste from the scholarship data from all over the world

Different success stories were told by the participants. For instance, Participant I mentioned the success of using virtualisation instead of a local computer, achieving high performance at

a minimal price. Participant K stated that his organisation donated their old computers to schools to help the students learn computer programming. Participant M's organisation built a new system that connects to 34 cultural missions around the world, and each cultural mission has several students who are studying overseas. This system is time-efficient for all employees and students, and minimises the amount of paper used in the management process.

4.2.4.2 Economy

The economy factor was intended to measure whether the new Green IT model impedes the current business process. Therefore, the new Green IT model has to retain the current IT performance or make it better. "Despite admirable product performance they grant sustainability regarding societal, environmental and economic aspects by no sooner entering into e-waste." (Khan et al. 2014, 12). Participants were asked whether the new Green IT model will positively or negatively affect their organisations' business processes. The question is: "Green IT endeavours to accomplish economic suitability and enhanced system performance and use. Do you think a new economic Green model will affect on your current business process? Positive or negative? If yes, why and no why!". The answers to this question are shown in Table 53.

Table 53 Participants' responses to the economy question

Participant	Answers
Participant A	Yes, will be positive,
Participant B	I think positive Green has a good reputation between people
Participant C	Yes, we will free from many operations that sometimes take time and slow the business process
Participant D	Positive as I said before I'm using cloud
Participant E	In the begging will be negative as any new system will effects the business process however in the future I'm sure will be positive since we have used a system that not harm the environment
Participant F	Yes, positive on long term run; because Green model ensures the high performance with minimising the environmental damages
Participant G	I think will be negative, our system not aimed to be economic, we are data security, so the most important thing to protect our data, any new system might be glitch our infostructure, means that more ports on our system for hacker to access to our data.

Participant H	I think positive we are using a very limited number of devices since we don't have data center and local server's Green IT model will easy to be applied.
Participant I	Yes, I think we'll go positive actually when we do an evaluation for each process in the green IT will consider the time and also the cost if it will cost I think yes
Participant J	Positive of course because we are selling the products that help to sustainability so it will affect us positively because it will increase our sales so this and term of financial profit
Participant K	Positively actually once we apply all the systems, it would be costly in the beginning but later on all increase efficiency of the business process and this efficiency if we can calculate it how going to be efficient as before it will be required for employees to speed up all the processes so these employees in salaries, so by applying the system efficiency as I said reducing all other processes.
Participant L	I think positive because you reduce cost in the printing system and papers hardware that you didn't need too many servers believe me once you reduce these you will save a lot of money printing is cost you a lot ink in Saudi is very expensive printer maintenance is very expensive so implementing green it will save you some money and in the positive factor what we don't look at all the time it will reduce the pollution of that one
Participant M	Well definitely it will be positive thing so in the long run having this green environment model definitely will make a success story and I don't think it will be having a bad quality of work so increasing the time for this new process in our current business process definitely it will be a great idea since we are increasing the quality of our products
Participant N	I think it will provide benefits because I see other companies and other countries adapted Green technology and environmentally friendly Technologies and there a reason to adopt at least efficiency better quality and low
Participant P	I think no effect but if I'm going to spend money on it will be negative effects, as long as no rules in place from Dubai from regulator perspective it doesn't matter so it's is going to be spending money on something that I don't need. however, if we have data centre and we going to change it to cloud it will be positive effect since will be reduced the price
Participant Q	Yes, for good we are changing from Data center to Cloud as I said before our business process much faster now even we are not completely changed, but our transactions go faster.
Participant R	I think it will be positive for sure as I said I think the green IT is applying always for a better more efficient business model in all their aspects as we are working in business environment I think yes, we are supporting the same Direction I think it makes sense to be positive for us.

Most of the participants believe that a Green IT model will bring positive benefits to their

business. In the case of Participant I, the organisation evaluates each process to consider the time and the cost, and takes these into consideration when using Green IT. Participant K believes that Green IT will be costly in the beginning; however, later it will be much cheaper and more efficient, and will reduce the number of employees. Participant Q's organisation changed from the data centre to cloud, and the result was a much faster business process, even though they did not completely rely on the cloud.

4.2.4.3 Environmental

The environmental factor investigates whether the new model is environment friendly after the installation process. There are different methods to ensure this, such as determining whether the new IT equipment meets the Green IT requirement and the IT process is designed according to Green IT concepts. "The extreme environmental conditions in Saudi Arabia increased the need to adopt sustainability measures in many fields" (Al-Gahtani et al. 2016, 41). Therefore, participants were asked whether they are applying any environmental considerations when purchasing or disposing of IT waste. The questions are "Pro-environmental IT practices is private-sphere environmentalism in the purchase, use, and disposal of IT". Are any of these terms used in your organisation? If yes why and no why?". The responses to this question are shown in Table 54.

Table 54 Participants' responses to the environmental question

Participant	Answers
Participant B	I don't think we do not use any of these terms in our company
Participant C	No, we are not using it here we do not follow plans for Green might in future
Participant D	No, we do not follow any plan here
Participant F	I think here they are looking for the lowest price with regardless of the environmental products Hope the change as soon as the young people be on the top manager
Participant I	For the purchase I think we not exactly go with this kind of concept we believe all the companies now in coming days they will go with this kind of Technology we focus on the performance because we believe all the companies the vendors companies they will go with this kind of concert because it is a technical requirement to start from Power and the heating and the temperature.
Participant J	I don't think it is a private sector it is used widely within our government and the private sector well when we usually buy from our OEMs we have our own

		standards and even the whole supply in the whole value chain we enforce our standard in our OEMs and then in our downstream.
	Participant K	We are actually looking for 2 ways we are looking for the quality of the product which is live longer so will no E-waste also we are looking for saving power products, so once we save the power and oil and so on.
	Participant L	They don't he just focused on whatever support so if it is a green or not green doesn't matter for them unless it will deliver supposed to you do ink daily basis work so they will be ok with that
	Participant M	Well we don't have this culture currently in Saudi but I will tell your story about we had a project for the IBM business process management system we didn't achieve to have the new services for the IBM products since we do not have the expertise about that and unfortunately, we had ended it
	Participant N	Actually, currently maybe just disposal only other aspects there are not taken into consideration they don't
	Participant P	Yes, we do use the pro-environmental product because actually cheaper to use and then we always compare what is liners and what is better and more environmentally friendly but if you look at and say that I'm buying and purchase IT products do we look at it from socially ethical protective nope
	Participant Q	We do not have any purchasing or using green plan here I think we need just time I believe it is very important and we need to install it

Most of the participants' organisations do not have any environmental plans for the purchase or disposal of hardware. The data shows that there is a lack of knowledge in this field due to the currently poor awareness of green practices. Participant I, focuses on the performance and anything else is secondary. Green IT needs to ensure that the performance will remain the same as before or might be better. Therefore, knowledge about Green IT is essential in GCC countries' organisations. Participant K stated that the organisation is looking at two things for any new product: the quality which extends the life of the product and the minimisation of waste, the power management of products. Participant Q stated, "We do not have any purchasing or using green plan here I think we need just time". Therefore, GCC organisations need the time and knowledge to shift to Green IT.

4.3 Interview finding contribution to the enhanced model

The researcher has changed the improved model to accommodate the new finding; this change was confirmed by participants in the survey stage. The new model now has more flexibility to be modified in the future, and many concerts have been changed to fit with the

new model. For instance, the researcher changed the “E-waste” term to “Recycle”, since “Recycle” is wider than E-waste in terms of sustainability. Figure 39 shows the first draft of the enhanced model after analysis of the interview phase, and Table 55 gives a summary of this chapter’s findings.

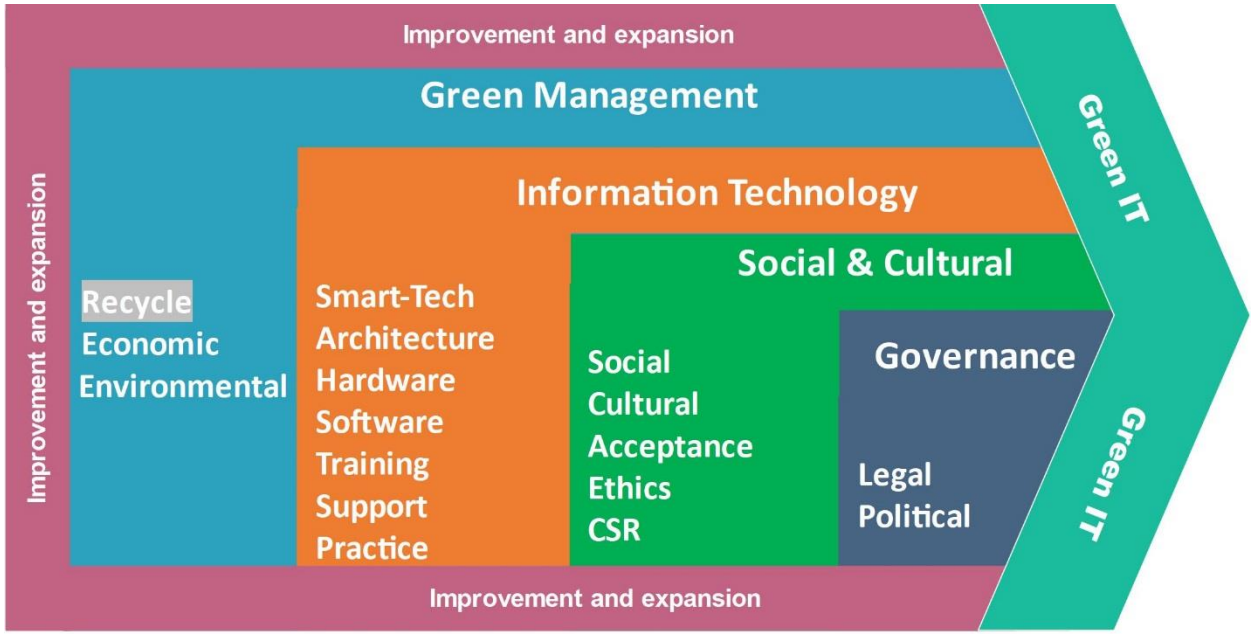

Figure 39. The new model after analysing the first phase data

Table 55. Summary of findings

Factor	Sub-factor	Finding	% participants mention
General	General	Due to the high investments of organisations in GCC countries in the last ten years, participants’ answers to the management question show that many business processes have been changed recently and they now apply these changes. Therefore, it is hard to determine an accurate answer due to the changes in the business process. To resolve this issue, the researcher added a new layer to the improved model. The new layer was placed under all four main factors named “Improvement and expansion”, the new Improvement and Expansion layer gives the flexibility to add or remove the enhancement model’s elements.	47%

IT	Software hardware	Governments in GCC countries are very strict about the data produced by their public entities. Various methods are used to destroy these data; all these methods must have an official approval; therefore, public entities in GCC countries are not allowed to make any sustainable decision that relates to the data. The government accepts a sustainable solution that matches their needs and provides useful services such as creating a private cloud to connect all public entities to one place. This solution is now under development in Saudi Arabia, which will make a valuable contribution to the sustainability field, and could be added to the enhancement model using the "development layer".	41%
IT	Software hardware	Public organisations and public entities operators require official approval from the government to share any data with the public. Recently, the Saudi Arabia government established an open-source project that allows government data to be viewed by the public, which will be useful for researchers worldwide (data.gov.sa).	35%
Social and cultural	Social acceptance	The best way to promote and change people's mindset in GCC countries about Green IT and sustainability is by using the social media, since it is very influential and social media is more popular than any other channel of communication.	52%
Social and cultural	cultural	Lately, people in GCC countries have made many cultural changes due to the influence of the social media; this provides good opportunities to add sustainability as one of the new cultural elements by forcing organizations to sustain and promote their products as sustainable. This will lead to greater social acceptance of Green IT concepts in GCC countries.	58%
Social and cultural	CSR	Organisations do not have a very clear plan for social responsibility due to the absence of control by the governments, and governments need to take action to force organisations to start their CSR program and will be much better if these programs are sustainable.	41%

IT	Smart tech Architecture	Email is the main communication tool in GCC organisations, which is a very good sign for using a sustainable technology in the public entities in the GCC countries. There are some difficulties to applying this technology mentioned by the participants; however, it is a very good start.	35%
IT	Hardware	One of the biggest problems for IT departments in GCC organisations is the use of unsustainable datacentres which acquire new equipment to meet each new demand. Also, they focus only the performance without taking into account the sustainability as well as reliability.	29%
IT	Software Practice	Some organisations are using sustainable tools for their normal work; they find these very useful to speed up the business process. However, organizations need more knowledge about using these tools to improve work practices	29%
IT	Training support	Each organisation has a different training program, depending on its budget. These programs need to include sustainability awareness to make Green IT more accepted.	35%
Green Management	e-waste	Change the e-waste to recycle; recycling has a wider spectrum that includes e-waste, plastic, physical and chemical recycling.	52%

4.4 Chapter summary

In conclusion, the qualitative analysis phase produced significant data elicited from personnel in top management positions in GCC countries. Data was collected from participants in all the six GCC countries, although most of this data was obtained from Saudi Arabian participants due to the size of the population and the large economy. The number of participants was 17, and all the interviews were conducting face-to-face. The findings from this stage of the research were confirmed using the qualitative method which is the survey phase since the researcher used the “Sequential Exploratory” design strategy of the mixed-methods approach.

As in-depth semi-structuring interviews are visual interchanges when an interviewee seeks to obtain data from an individual by asking questions, the researcher used semi-structured in-depth interviews to collect the data. The researcher also provided information explaining the issue prior to asking set questions followed by subsequent questions prompted by the previous answer. This method of asking questions gives the participants more knowledge about the topic and produces more accurate results. For analysing the data, the researcher used NVivo Ver.11 software due to the features it offers for qualitative research. All data are available for access by a number of people authorised by the researcher and his supervisor. The data was valid according to Galvin (2015), and the researcher received positive feedback from the interviewees who asked for the final results produced by the current research for possible application within their organisation. A number of public entities in GCC countries already implement very advanced Green IT concepts. However, government regulations are slowing the process of improvement in the sustainability field. The next chapter will describe the survey stage in which the main data for this study is collected and analysed.

CHAPTER 5. SURVEY PHASE

5.1 Introduction

The previous chapter the researcher conducted interviews and analysed interview data obtained from top management personnel in GCC countries. This chapter is the next phase of the research data collection which is done via a survey. The targeted participants for this phase are divided into three categories: managers, IT personnel, and non-IT personnel.

This chapter presents the second data collection method (quantitative) that will refine and confirm the data gathered from the qualitative phase (interviews). The first step is to design the research questionnaire and decide who will be the targeted population sample for this phase. The main survey respondents for the Green IT and sustainability model are managers, IT employees, and non-IT employees; each one of these participants belongs to a different category that will be discussed in more detail in subsequent sections. This chapter will cover the survey responses data, demographic profiles, analysis techniques, and all results. The final survey finding for all the three categories will be combined for the final Green IT and sustainability model. In the next chapter, all findings are presented and discussed

5.2 Survey Design

As this research used a mixed-methods approach, the researcher chose one research design as a guide for the data collection. The research adopted the Sequential Exploratory design, which means the first phase is qualitative followed by quantitative (Creswell, 2013). The survey data consolidates the findings from the interview stage and reduces the number of factors by means of Exploratory Factor Analysis (EFA). The following subsection will explain the overall structure used in this chapter.

5.2.1 Survey structure

The survey research has three main structures; each structure aims to cover different survey themes for each participant category. The themes for the survey are governance, social and cultural, information technology and green management. The main targeted participants were categorised according to four different sections: CEOs, managers, IT personnel and non-IT personnel. However, this design was as slightly changed due to the few numbers of CEOs

who responded. The researcher has combined both CEOs and managers under one category; this change is justified later. Each participant category answered a different set of questions. Managers answered questions for governance, social and cultural, and green management. IT-personnel answered questions on the main theme of this research, which is information technology, as well as social and cultural, and green management. Lastly, non-IT personnel answer questions for only two themes, which is social and cultural, and green management, as shown in Figure 40.

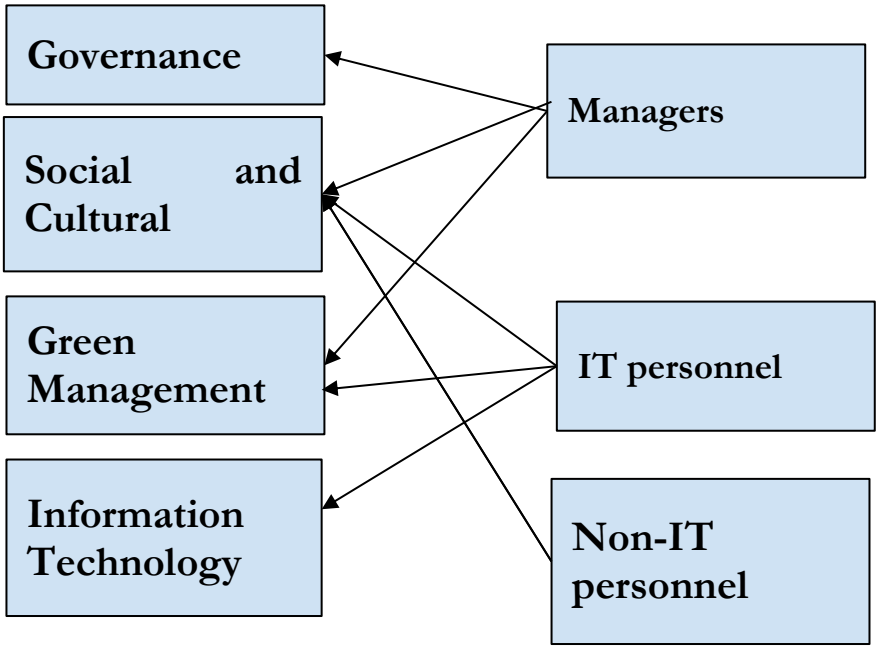

Figure 40. The survey structure of the Green IT model -developed by the researcher

5.2.2 Survey items and contents

Each participant required to state his/her job position at the beginning of the survey, then the survey tool would automatically appear for subsequent questions based on the stated position. The survey questions were derived from the interview data and the literature review. The questions asked were based on the participants' job position, as shown in Figure 40, to ensure that all items relevant to a Green IT and sustainability model for GCC countries, were covered. At the beginning of the questionnaire, the researcher asked general questions to collect the demographic data. These questions were presented as multiple choices in single and matrix format for various answers. Also, the first part of the survey comprised a five-point Likert scale anchored by 'strongly agree', 'agree', 'neutral', 'disagree', and 'strongly disagree'. Each theme (for example, managers have three themes: Governance, Social and Cultural, and Green management) is dealt with on a single page. In addition to having the demographic page, managers saw four pages, IT-personnel four pages, and non-IT personnel had three pages.

The researcher conducted multilabel testing on several people to test the timing of the answer, and the results showed that 10 to 12 minutes would be required to complete the questionnaire. All the items and their sources are presented in Appendix 5.

5.2.3 Developing the survey questions

Qualtrics was used for conducting the survey, which is a web-based tool to design a survey and distribute it to the targeted audience. Besides, Qualtrics can be used to print the survey questionnaire as a hardcopy for physical distribution. The single format section contained the demographic questions, and the matrix format was used for the structured model as shown in Figure 41.The first step in developing the survey questions involved the design of the initial prototype model using the data from both the literature review and the qualitative phase. After designing the initial survey questionnaire, the researcher met with the supervisor multiple times to ensure all area were covered. The first draft was posted to the online tool for testing; after that, the pilot survey test was sent to three experts, the supervisor, PhD candidates and an IT department manager. As a result, several changes were made to the questions' structure to ensure that they were accurately interpreted by all participants. For example, one of the social section questions was repeated three times, with only the last word being changed. It was recommended that the researcher write the questions once only and repeat the last word in different items as shown in Figure 41, which would save time and maintain the participants' attention.

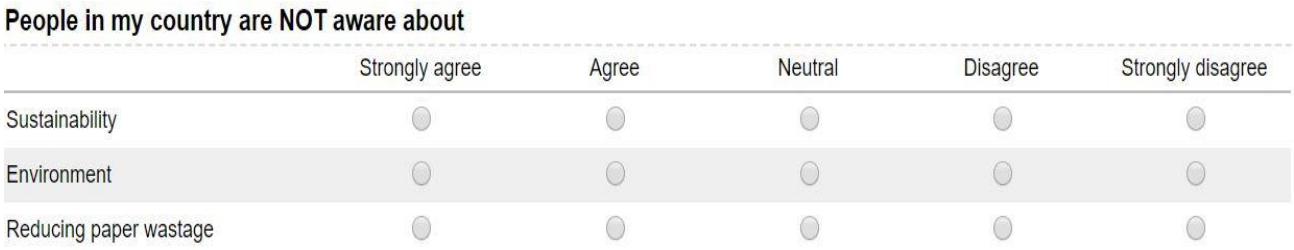

Figure 41. Example of changes to the question structure

After all new changes were applied, the new version was discussed with the supervisors as well as other experts for final approval. Then, the researcher applied for approval from the Curtin Ethical Committee. The approval letter is shown in Appendix 2. Subsequently, the main distribution of the survey questionnaires was begun and, later, the data collection was accomplished via different methods. The survey process design explains all stages up to the final stage which is the analysis as shown in Figure 42

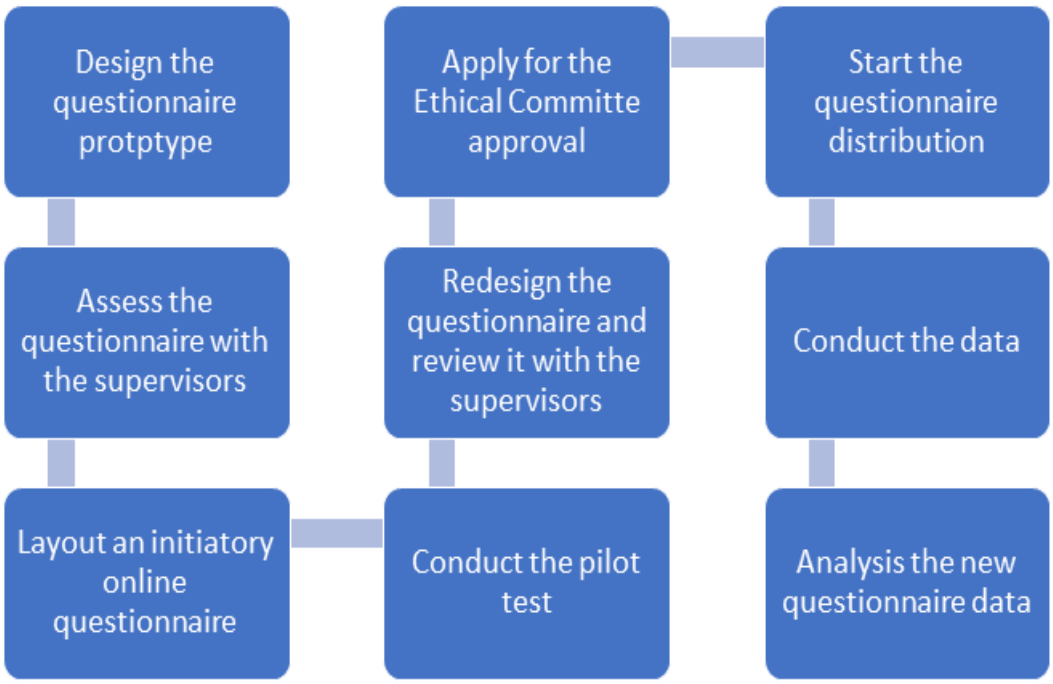

Figure 42 Survey design process -developed by the researcher

5.3 The survey population and Administering

As previously mentioned, the survey targeted three different categories of participants: managers, non-IT personnel and IT personnel. All participants were required to be from GCC countries and the survey was written in both languages, Arabic and English, since most people in the GCC region speak Arabic and have English as their second language. However, due to the lack of responses from CEOs, the manager category was combined with CEOs and top manager under one category named “Managers”, as both CEOs and top-level managers responded to the same questions as shown in Table 56. Therefore, for the Governance section, only managers (CEOs and top-level managers) had access to the questions. Information Technology targeted only IT personnel as they have the ability to answer the technical IT questions. Lastly, all participants are able to answer for both section Social and Cultural, and Green Management.

Table 56. The new change to the targeted people for the survey – developed by the researcher

	Managers			
	CEO	**Managers (high-level)**	**Non-IT personnel**	**IT personnel**
Governance	✓	✓	✕	✕
Information Technology	✕	✕	✕	✓
Social & Cultural	✓	✓	✓	✓
Green Management	✓	✓	✓	✓

In general, the survey examines the Green IT and sustainability model in the GCC region; personnel from any department could respond to the questionnaire, although one section was for IT personnel only. The questionnaire asked each participant demographic questions regard to their current position and field of experience. The researcher conducted the survey using the Qualtrics online tool, and the Qualtrics print feature to produce hard copies for manual distribution.

The survey was distributed using different methods and stages to reach a valid sample size as shown in Figure 43. The first stage involved sending a direct message to managers using the Linkedin network for two reasons, make the managers answer to the survey and ask them to distribute the survey among their employees. The duration time for this stage was roughly four weeks, and most of the responses came from non-IT personnel.

The second stage was to send a single, official email to managers asking them to answer the questions, as the number of managers was insufficient. The response was good enough as the number of emails sent to manages was high. However, most of the response were from managers, not CEOs although this category was targeted for the survey as well. Almost seven weeks after the survey had begun, only one CEO had responded. The researcher was in Riyadh, the capital of Saudi Arabia, during this survey phase. The researcher decided to make hard copies of the questionnaire and use personal contacts in Saudi Arabia and other GCC countries to distribute the questionnaire to CEOs.

Therefore, as one Qualtrics feature is the ability to print the survey as hardcopy, the researcher printed the survey questionnaire for himself and sent it as a PDF file to his personal contacts in Dubai and Manamah. Then, the researcher organised personal meetings with three CEOs. Two of them answered the survey questionnaire immediately; the third said that he would answer it and send it to my email address, which does not happen. Then, the researcher met with another three CEOs through a friend at an unofficial meeting; they answered the survey questionnaire as well.

During this the process, many responses were received from other categories, as we asked each one them to distribute the survey. At the end of the survey, the total number of CEOs was 17 and the managers were 81. Therefore, we decided to combine both CEOs and managers under one category as both were required to answer the same questions. The total number of managers was then 98, which was sufficient for factoring analysis.

Therefore, to speed up the process, the researcher used social media to distribute the questionnaire, such as WhatsApp; this ensured that the number of responses was adequate, especially in the non-IT personnel category. Overall, the survey had 654 responses; the greatest number of participants were non-IT personnel accounting for 69% of all participants. IT-personnel accounted for 16%, and managers accounted for 15% as shown in Figure 43.

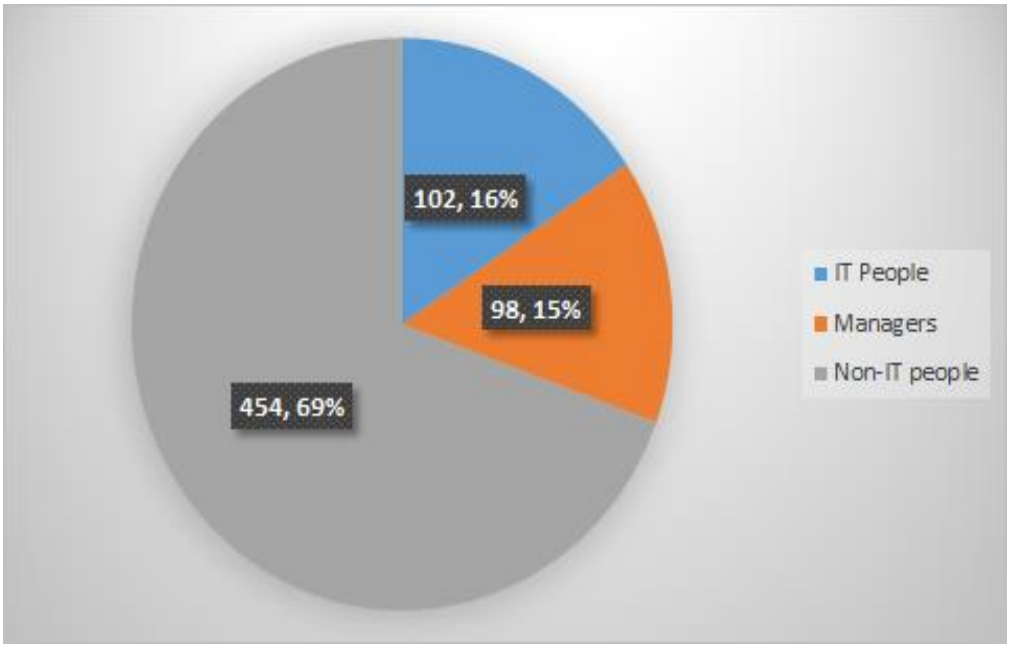

Figure 43. Pie graph showing the number of participants

At the beginning of the survey distribution stage, the researcher began to target the education sector. However, the researcher received very few responses from IT users, as IT personnel

should answer the main section of the survey which pertains to information technology. After that, the researcher began to contact IT managers in different sectors in the GCC to answer the questions and distribute the survey. As a consequence, many respondents were secured for the study. However, the number of managers fell short of the target number; thus, the researcher printed the survey and distributed the hard copies via personal contact using the snowball technique.

5.4 Pilot Survey

As indicated in 3.7, a pilot study is essential to pre-test the survey questionnaire to identify any issues that might arise in terms of, for instance, technical wording and statement order issues. Therefore, the survey questionnaire was sent to 19 experts in the GCC region. Out of the 20 practitioners, only 12 responded to the survey, giving a response rate of 63%. Table 57 presents the profiles of the 12 experts who completed the pilot survey. Eight of the 12 responses indicated that the survey was straightforward and easy to follow. However, the rest gave some feedback regarding the wording and order of statements. Their comments were addressed in the final version of the survey.

Table 57. Profiles of experts who completed the pilot survey

Job role	Number	Percentage
Manager	**1**	**8.3%**
IT-personnel	**4**	**33.3%**
Non-IT-personnel	**7**	**58.3%**

5.5 Respondents' demographic profiles

Participants' demographics helps the reader to form a visual image of the research's participants (Hetzler and Turner, 2004). The demographic pie below (Figure 44) summarises the respondents' job profiles.

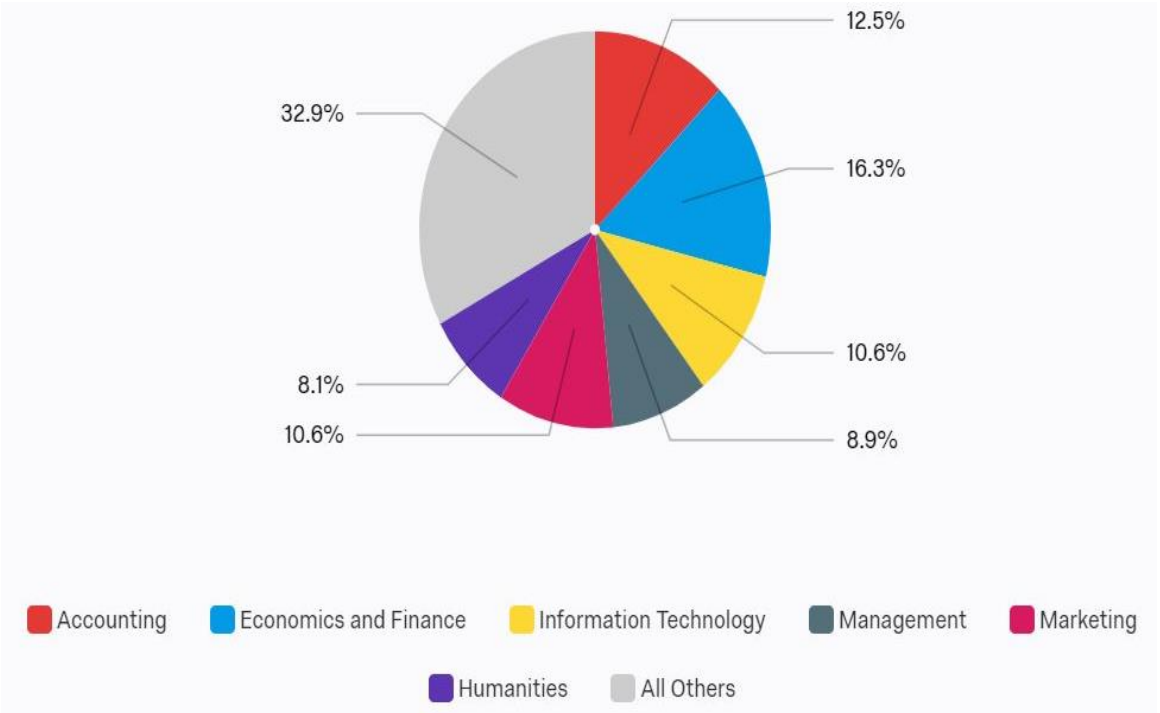

Figure 44. Respondents' job titles

As seen from the figure, respondents' significant fields are Economy and Finance (16.3%), Accounting (12.5%), and Information Technology (10.6%). The figure shows that the majority of non-IT personnel have positions in Economy and Finance, accounts department, as the response rate of non-IT personnel is 69% of the overall participants. The researcher uses their personal relationship to access for accounting company for distribution, the company start a snowball sampling technique as a start point, and that implies how the accounting field has 12.5% of the overall responses. "A sampling procedure may be defined as snowball sampling when the cc through contact information that is provided by other informants" (Noy 2008, 330). The primary target for the survey is information technology, but this accounts for only 10.6% of respondents.

Most of the responses were from males (70.5%), while females accounted for 29.5% of overall responses, as shown in Figure 45. However, this number of women is interesting and indicates how the number of women in organisations in GCC countries has increased. A previous study by Skoko (2012) that analysed entrepreneurship characteristics in the largest country in the GCC, Saudi Arabia, showed a large gender gap regarding the number of employees in Saudi Arabia, where 85% were male and only 15% were female. The survey asked the participants to indicate their age by choosing one of six different age groups: 20 years and under, 21-30, 31-40, 41-50, 51-60, and over 60. The result was 1.64%, 24.3%, 35.4%, 24.9%, 11.9%, and 1.7% respectively.

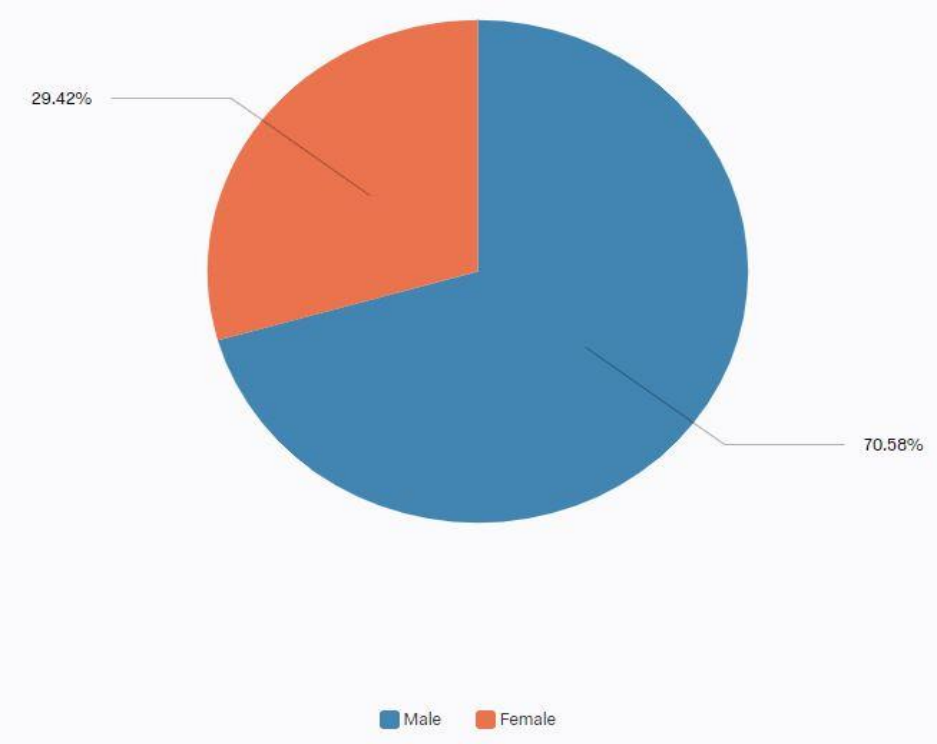

Figure 45. Survey participants' gender

Participants were also asked about their work experience, as shown in Figure 46. Those who were new in their jobs and had less that one year's experience, accounted for 4.6% of the participants. Responses indicated that 20% of participants had more than five years of experience. Lastly, 75% of respondents had between one and five years of experience. GCC countries have a youthful population, the youngest age median is for Oman (24.3 years) and the highest median is for the UAE (31.7 years) (Sultan *et al.*, 2012). Therefore, most employees in GCC countries are relatively young, as the survey shows that almost 80% of the respondents have less than five years' experience.

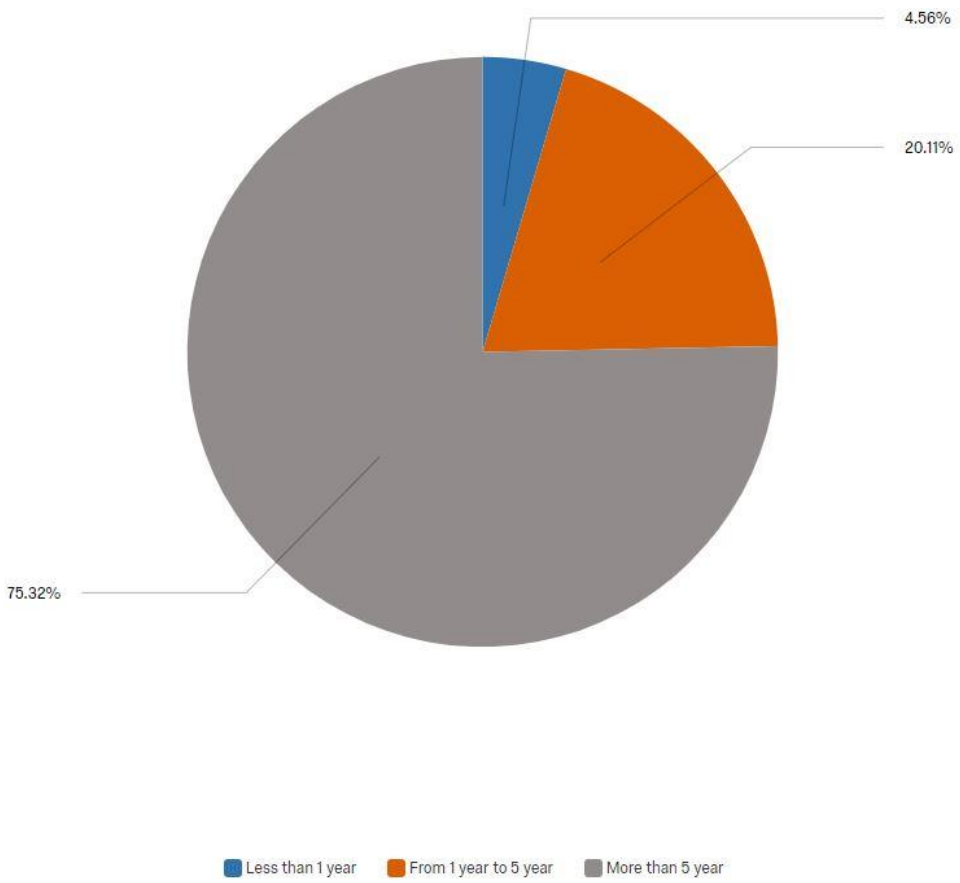

Figure 46. The survey participants' work experience period

The survey shows that most of the participants have a bachelor's degree compared to all the categories as shown in Figure 47. Most of the non-IT personnel from non-IT departments, have a bachelor's degree, followed by personnel with a master's degree. However, the number of personnel in IT departments that have a master's degree is large compared to that of non-IT personnel. In 2005, Saudi Arabia started a scholarship program called King Abdullah Scholarship Program (KASP), sending Saudi student to study overseas as part of Saudi Arabia's knowledge-based economic vision (Altuwaijri, 2018). The program has targeted technical fields such as medical, engineering and computing as priorities for the student to be accepted in the program. Therefore, the number of employees who have a master's degree in IT departments is the result of the long-term Saudi vision reflected by the scholarship program.

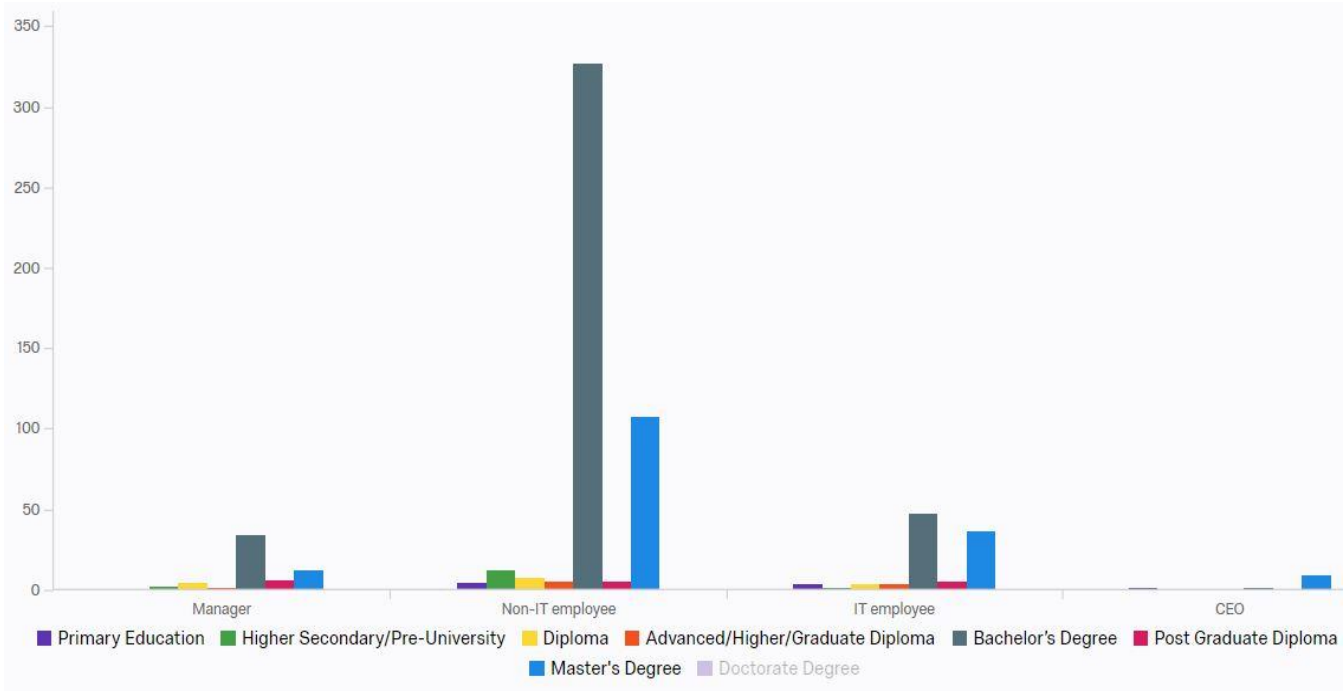

Figure 47. The participants' education level

Lastly, the participants were asked a general question to indicate whether and how they practise Green IT in their daily lives. The question was "*how do you contribute to sustainability in your everyday activities*?". The results presented in Figure 48 show that the majority (45%) are doing nothing in their daily lives regarding sustainability. There are still issues in applying sustainability regulations in some GCC countries. For example, there are no recycling bins and little awareness of the Green IT concept. Only 13% of respondents are recycling their waste, which is a very low contribution to safeguarding the environment.

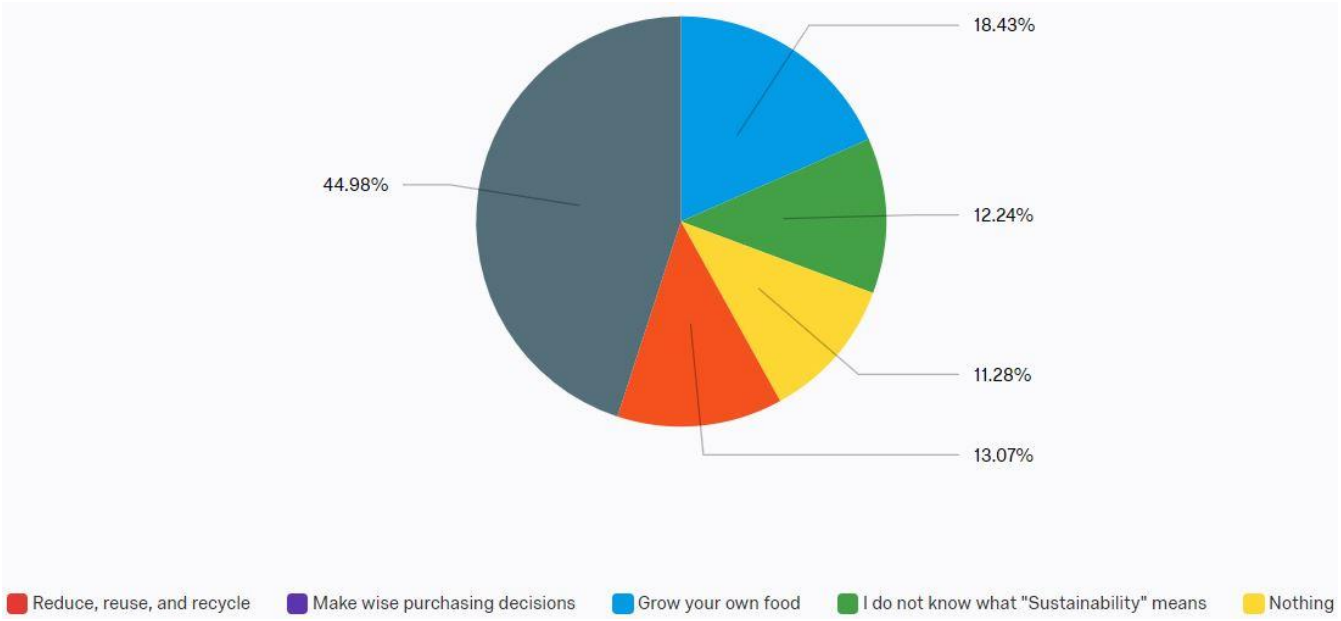

Figure 48. Participants' answers to how they practice Green IT in their daily lives

5.6 Descriptive Analysis

This section discusses the descriptive analysis used for each participant's category at the beginning of each analysis; the discussion is based on the Green IT and sustainability model before the factor analysis. Likert scales are commonly used in different fields such as behavioural sciences, medicine, education and studies on usability. Participants indicate their level of consent to statements with usually five or seven prescribed rates of response to a Likert scale (de Winter and Dodou, 2010). "Likert item data have distinct characteristics: discrete instead of continuous values, tied numbers, and restricted range" (de Winter and Dodou, 2010, 1). This research used a five-point Likert scale for the survey phase. The five points are: (1) strongly agree, (2) agree, (3) natural, (4) disagree, (5) strongly disagree. The analysis will discuss the mean and standard deviation to deliver an overall idea regarding the responses. Therefore, a "mean" closer to one indicates strong agreement; a mean closer to number five indicates strong disagreement. This section gives an overall idea of the key variables for better understanding of the data before the factor analysis.

5.7 Survey Data Analysis – Factor Analysis

The survey was analysed in two steps, firstly obtaining the data for each participant category using SPSS version 25 to check whether each enhanced factor was factorable, and then factor extraction was conducted for each theme using Exploratory Factor Analysis (EFA).

Exploratory factor analysis aims to group items based on the induction of variables (Hair *et al.*, 2010). EFA is the basic factor analysis technique used to determine the validity and reliability of items (Suhr, 2006). Technically, EFA discovers and defines the new factors and measures the relationship between these factors.

5.7.1 Exploratory Factor Analysis

As shown in Figure 49, EFA has a sequential processing that was introduced by (Williams, Brown and Onsman, 2012); the first step is establishing all the factors, then the right techniques for extraction are selected; thirdly the number of factors is generated, fourthly the right rotation method is executed; lastly, the factors and their items are identified. Therefore, for analysis of the survey data, the EFA technique is the main one as it has clear steps and is easy to follow; each step will be described briefly in the sections below.

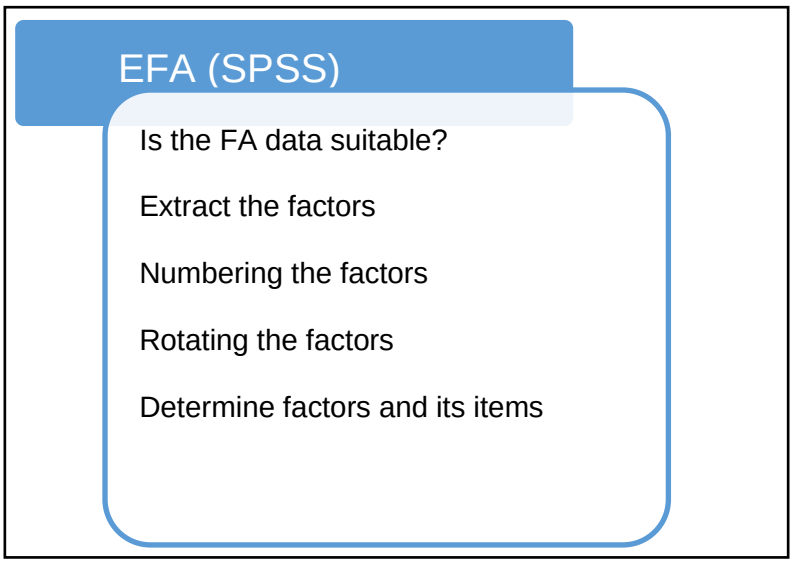

Figure 49. Survey data analysis process

5.7.1.1 First step: Is the Factor Analysis data suitable?

There are several criteria for determining whether the data is suitable for factor analysis. For instance, in the case of a small number of participants, Tabachnick & Fidell (2014) suggested a sample size number of at least 300 be factorable in a group of three or more items. This research has three main categories of managers, IT-People and Non-IT personnel. Only Non-IT personnel met the minimal number of Tabachnick & Fidell (2014) suggested numbers. In the case of Non-IT personnel, the sample size is 454 participants, which is large enough for factor analysis. However, the issue with both Managers and IT personnel as the sample size is in range of 100 participants.

Hair et al. (2010) recommended that research with a small sample size choose factors with high loading. In this research only, factors with 0.45 or higher were accepted for all themes. Also, Hair et al. (2010) suggested that when there is a small number of participants, the factors and their items be subjected to a variable ratio, to analyse the correlation coefficient to ensure the factorability; the suggested variable ratio is 5:1 and above. The correlation matrices should not be less than 0.30 (Tabachnick and Fidell, 2014).

SPSS can determine another test that will be subjected to this research as well, which is Bartlett's test of sphericity (Bartlett, 1954) and Kaiser-Meyer-Olkin (KMO) (Kaiser, 1974) test of sampling adequacy; in order to be acceptable results for Bartlett's test should be above 0.05 and for KMO they should be over 0.6. All previous measurements considered in this research will be shown in the next sections.

5.7.1.2 Second step: Extract the factors

In general, the survey data was ordinal analysed in EFA, which means it is not suitable for normal distribution. The most common way to extract factors is either Maximum Likelihood (ML) or Principal Component Analysis (PCA) (Schmitt, 2011). ML's best feature is that it has high factor stability even in the uncertainty of a specific model; but one of ML's requirement is the survey must be a normal distribution (Schmitt, 2011; de Winter and Dodou, 2012). However, PCA does not require data normalisation and produces the same outcome for its factors (Schmitt, 2011). Therefore, the PCA is chosen for this research as it is more appropriate for the type of data.

5.7.1.3 Third step: Numbering the factors

Several approaches can be used to detect the number of factors using SPSS; the most well-known approaches are eigenvalue, parallel analysis and scree plot (Hair *et al.*, 2010; Pallant, 2013). Eigenvalue calculates the total variance of the factors and shows all factors that have an eigenvalue in a range of one. This step is vital at the beginning of the analysis to determine the number of factors (Tabachnick and Fidell, 2014). The scree plot is an approach that finds a visual elbow based on the eigenvalue to determine the values before the break; SPSS gives the ability to change the break value as well as choose the number of factors. This approach is dependent on the researcher's justification for the break value and the data needs (Williams, Brown and Onsman, 2012).

Parallel analysis involves a scree plot to determine the statistically significant eigenvalues by randomly generating eigenvalues using an algorithm that generates data like actual data

(Pallant, 2013). The data for the parallel test can be generated by a different resource. However, this research uses (Patil *et al.*, 2008) a software engine, which needs to specify only the survey details; the engine will generate the eigenvalues. Once both actual and random data are generated, only the eigenvalues for the actual data that are higher than random data are accepted (Hayton, Allen and Scarpello, 2004). A combination of scree plot test and parallel analysis will ensure an accurate result (Williams, Brown and Onsman, 2012).

Therefore, this research used all approaches to determine the number of factors, and to test the accuracy of the results. Firstly, the eigenvalue strategy was applied to obtain the valid factors. Then, the scree plot was generated to determine the elbow break for all factors. Lastly, the results were confirmed using parallel analysis to ensure the accuracy of the eigenvalue.

5.7.1.4 Fourth step: Rotating the factors

Rotating the factors involves identifying and interpreting the factors by grouping each factor's items based on their correlation value (Hair *et al.*, 2010; Sass and Schmitt, 2010). Factor rotation can be accomplished with one of two commonly-used methods: orthogonal and oblique. Orthogonal is mainly used for uncorrelated factors and oblique for the correlating factors (Osborne, 2015). Varimax is one of the orthogonal strategies and is widely used due to its clarity and explicit details (Portes and Aguirre, 2016). This research adopted the orthogonal method. The researcher initially applied the oblique method; however, most of the factors did not correlate. Hence, the orthogonal varimax method was used due to its clarity in interpreting the findings.

5.7.1.5 Fifth step: Determine factors and related items

This is the final step involving factor extraction and the identification of all valid factors. This step uses SPSS to obtain the loading factor variables and their elements. "A factor loading for a variable is a measure of how much the variable contributes to the factor" (Yong and Pearce, 2013). A higher factor loading result indicates a strong relationship with variables (Yong and Pearce, 2013).

However, the factors are not generated automatically. Their reliability needs to be tested using Cronbach's alpha test to evaluate each factor and its items (Saunders, Lewis and Thornhill, 2015). "The closer Cronbach's alpha is to 1, the higher the internal consistency reliability" (Sekaran, 2003). "Researchers will also need to determine the cut-off for a statistically meaningful rotated factor loading" (Yong and Pearce, 2013). Therefore, the researcher needs

to determine each factor loading to check whether it is within the acceptable range as shown in Table 58 suggested by (Comrey, Lee and Lee, 2013).

Table 58. Suggested factor loading scores according to (Comrey, Lee and Lee, 2013)

Factor loading score	Indication
Above 0.7	**Excellent**
Between 0.7 and 0.63	**Very good**
Between 0.63 and 0.55	**Good**
Between 0.55 and 0.45	**Fair**
Below 0.45 to 0.32	**Poor**

Lastly, we need to determine the commonalities for each item in order to decide which item should be retained under which factor. Items' communalities close to number 1 indicate a good relationship and less than 0.3 mean that the item does not belong in that group and should be deleted to improve the validity of results (Pallant, 2013). For a sample size between 100 and 200 (MacCallum *et al.*, 1999), the recommended communalities score is 0.5 and above and is therefore used in this research.

5.7.1.6 EFA Summary

To sum up all previous sections, Table 59 shows each step and the value for each item. The column on the left shows the steps of the PCA factor extraction method. All the values are given in the column on the right.

Table 59. EFA requirements summary

Step	***Values***
1: Determine whether the FA data is suitable	Item correlations >= 0.3
	Bartlett's test < 0.05
	KMO > 0.6
2: Extract the factors	PCA
3: Number the factors	eigenvalues > 1
	Scree test
4: Rotate the factors	Varimax
5: Determine factors and their items	Cronbach α > 0.7
	Factor loadings ≥ 0.45
	Communalities > 0.5

5.8 Survey Results and analysis

The results of the analysis of the survey data are presented in this section. This last phase leads to the final Green IT and sustainability model presented at the end of this chapter. The research has three data sections; each section has different factors and their items. Each theme of the model in this section is discussed in the next sections.

5.8.1 Managers

The manager section has three themes: governance, social and cultural, and green management, as shown below.

5.8.1.1 Descriptive statistics

Table 60. Descriptive analysis for governance in manager section

	Statement	Mean	Std. Deviation
Legal			
1	Green IT projects in business (such as using E-mail) profitable for the government	2.35	1.325
2	Green IT projects in business (such as using E-mail) profitable for organizations	2.45	1.123
3	Organization should save natural resources	2.27	.868
4	Organization should encourage their employees to stop using paper	2.11	.895
5	Organization should use sustainable materials	2.09	.975
Policies			
6	Implements a Green IT model will cause a political issue	2.43	1.193
7	Implements a Green IT model is affecting our international reputation	2.57	1.332
8	Developing Green IT concepts will reduce the operations cost	3.87	.755
9	Developing Green IT concepts will reduce the operations time	2.10	.958
10	The government should adopt a regulations usage of CO2	2.31	.913
	Average	**2.455**	**1.034**

The average mean for the Governance theme is agreed close to neutral at (M 2.455, StdD 1.034), which means close to agree, as shown in Table 60. However, managers think that developing Green IT concepts will not reduce operational costs (M 3.87, StdD 0.755) which has the lowest frequency of responses to statement number 8. The Green IT tools are currently not widely available in GCC countries, which might be costly for the organisations intending to implement a Green plan. For instance, Amazon Web Service (AWS), plan to

establish their business in the Middle East in 2019 by opening the first data centre in Bahrain to serve all Middle Eastern countries, including GCC (AWS, 2017). The most agreed-with statement is number 5 (M 2.09, StdD 0.975) “Organization should use sustainable materials”, which indicates that managers admitting that organisations are not using sustainable material.

Table 61. Descriptive analysis results for Social and Cultural in manager section

	Statement	Mean	Std. Deviation
	Social		
1	People are not aware about Environment	2.60	.982
2	People are not aware about Reducing paper wastage	2.41	.797
3	The most-used media channel is Social media	1.97	.779
4	The most-used media channel is Television	2.24	.874
5	The most-used media channel is Newspapers	2.35	1.113
	Cultural		
6	We have to Separate bins to rubbish and recycle	1.80	.930
7	We have to Use only recycled paper in school books	1.97	.843
8	We have to Reduce paper usage in schools by utilizing technology	2.12	.987
9	We have to include sustainability in the school curriculum	2.17	.985
	Acceptance		
10	Green IT will help to change the attitude towards the environment	2.24	.953
11	Green IT will help to change the way we accomplish our tasks	2.26	.829
12	Green IT will help to change ideas about accepting new systems	2.20	.963
13	Social media is the best way to change people’s attitude toward sustainability	2.02	.837
14	Social media is increasing people’s acceptance of a Green IT model	1.86	.825
	Ethics		
15	Current job is helping me to change my mentality	1.99	.936
16	Current job helps me to apply what I learnt in my work to my personal life	2.03	1.020
17	Current job is encouraging to change behaviour to become a better worker	2.23	.939
18	Companies that claim to be environment-friendly are attracting for purchasing	2.31	.890
19	Companies that claim to be environment-friendly are my preferred than are not	2.40	.917
	Corporate Social Responsibility (CSR)		
20	Organisations are responsible regarding social issues	2.81	.991
21	Organisations have funded social and community projects	2.58	.962
22	Organisations need to be more aware of their corporate social responsibility (CSR)	2.13	.970
23	The government should force organizations to be responsible regarding social issues	2.13	.927
24	The government should raise public awareness about CSR through the schools	2.01	.867
	Average	**2.201**	**.921**

On the other hand, as seen in the Social and Cultural theme in Table 61, participants responded to 24 items divided into five factors. Only five items had a frequency below than two, number 3, 6, 7, 14 and 15. Statement number 3 “The most-used media channel is Social

media" (M 1.97 StdD 0.779) and statement 14 "Social media is increasing people's acceptance of a Green IT model" (M 1.68, StdD 0.825), shows managers' agreement with these statements, as most people in GCC countries are using social media as their main communication and information-sourcing tool than any other media. The statement with lowest frequency is number six "We have to separate bins to rubbish and recycle" (M 1.80, StdD 0.930), indicating that managers are willing to change the current rules, as waste segregation is yet to be applied in most of the GCC countries. The average score for all 24 statements is (M 2.201, StdD 0.921), which means managers are in the agree side of the Social and Cultural analysis.

Table 62. Descriptive analysis results for Green Management in manager section

	Statement	Mean	Std. Deviation
Recycle			
1	Recycle (for example paper and equipment) is in our organisation	2.98	1.292
2	Reusing our equipment in our work	2.70	1.028
3	The government is applying for the recycling program	2.44	.942
4	The government is providing channels for accepting discarded machines	2.32	1.118
5	The government is using email to contact them	2.03	.925
Economic			
6	Cloud storage will be cheaper in the long run	1.68	.667
7	Cloud storage is easier to maintain	1.78	.856
8	Updating and upgrading computers is very costly	2.29	.952
9	Updating and upgrading computers is takes a long time	2.38	.936
10	Updating and upgrading computers is makes it hard to destroy old data	2.44	1.016
Environmental			
11	Organizations are concerned about purchasing environment-friendly products	2.46	.864
12	Organizations believe that price is not an issue if the product has better features	2.39	.833
13	Organizations uses several environment-friendly products	2.58	.849
14	Organizations have developed a sustainable application in our systems	2.55	1.047
15	Organizations encourage us to use environment-friendly products	2.53	1.067
	Average	**2.37**	**.959**

For the Green management theme, as shown in Table 62, participants were asked to respond to 15 items regarding three factors: Recycle, Economic and Environmental. The main purpose

of the Green Management section is to investigate the elements that might affect a new Green IT model. The most agreed items, which scored less than two, are “Cloud storage will be cheaper in the long run” (M 1.68, StdD 0.667) and “Cloud storage is easier to maintain” (M 1.78, StdD 0.856). Both items investigate the cloud storage in business, which means managers believe that cloud storage will benefit their business due to the various services that cloud computing can offer to the businesses. The average scores for answers are (M 2.37, StdD 0.959), which means managers agree on most of the Green Management statements.

5.8.1.2 EFA Managers Analysis

The aim of this section is to analyse the survey data of managers using the exploratory factor analysis method.

5.8.1.2.1 Governance

As mentioned previously, only managers were required to answer items for the governance theme. The “legal” factor items were intended to discover whether the present structure of the Green IT model is legally affected by the business process.

The second factor, "policies," which had earlier been “political”, shifted to policies after the interview assessment; is investigating the current policies for adopting new model. After multiple testing and removing the low contribution items, the results are as shown in Figure 50; the governance theme has good reliability indicated by the total Cronbach's Alpha of 0.777 and the Kaiser-Meyer-Olkin Measure (KMO) score of 0.700, and significant Bartlett’s test result of ($p < 0.001$).

Reliability Statistics

Cronbach's Alpha	N of Items
.777	8

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.708
Bartlett's Test of Sphericity	Approx. Chi-Square	323.904
	df	28
	Sig.	0.000

Figure 50. Cronbach's Alpha, KMO and Bartlett's tests

The factor analysis (PCA) determined the factorability of eight items, and the results of item correlations are above 0.45. This results in two factors and each factor’s contribution to the total variance is 41.7% and 24.3% respectively, and both factors represent 66% of the total

variance, as shown in Table 63.

Table 63 The total variance results

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.335	41.689	41.689	3.335	41.689	41.689	3.125	39.067	39.067
2	1.946	24.320	66.010	1.946	24.320	66.010	2.155	26.943	66.010

The scree plot marking at the elbow is above the number one indicated by the orange arrow shown in Figure 51.

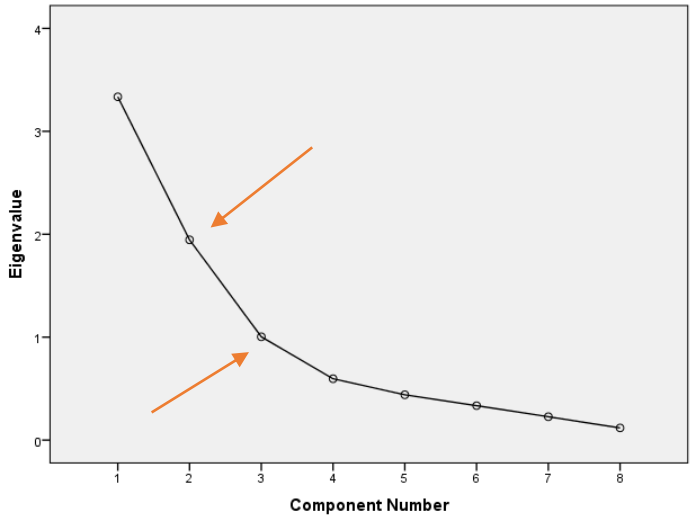

Figure 51. the elbow marking in the total component number

Initially, several tests were applied to three variables, although the Cronbach's Alpha score was not significant. Therefore, SPSS was used to generate two factors to increase the alpha test score, as well as accomplish a good communality contribution for each item. Furthermore, certain items were removed because of cross-loading with other elements and small community contribution.

Finally, a parallel experiment should verify the number of values by using a web-based instrument by (Patil *et al.*, 2008) researcher framework. The web tool asks for the survey details and generates analysed eigenvalues based on (Patil *et al.*, 2008) data. The results are shown in Table 64. High eigenvalues indicate the acceptability of factors for further analysis.

Table 64. Parallel test for Governance theme

Factor	Actual Eigenvalue	Generated Eigenvalue	Decision
1	3.335	1.430717	Accepted
2	1.946	1.277047	Accepted
3	1.004	1.140850	Rejected

The summary of the EFA analysis results are shown in Table 65. Due to their small contribution to the model, a range of factors were removed.

Table 65. Summary of the factor analysis results

		Factors Items	Factor code	Factor loading		Communalities
				1	2	
Factors	Sustainable resources	Organization should save natural resources	MGL21	.871		.803
		Green IT projects in business (such as using E-mail) profitable for organizations	MGL12	.847		.863
		Organization should encourage employees to stop using paper	MGL22	.780		.541
		Green IT projects in business (such as using E-mail) profitable for the government	MGL11	.762		.710
		Organization should use sustainable materials	MGL23	.615		.418
	Green IT Procedures	Developing Green IT concepts will reduce the operations time	MGP22		.882	.778
		Developing Green IT concepts will reduce the operations cost	MGP21		.795	. 634
		The government should adopt a regulations usage of CO2	MGP31		.701	.571
		Cronbach Alpha test		**.832**	**.742**	

The findings with the newer variables for the governance theme are shown in Figure 52. The new factors are named ‘sustainable resource’ and the second factor is named ‘Green IT procedures’.

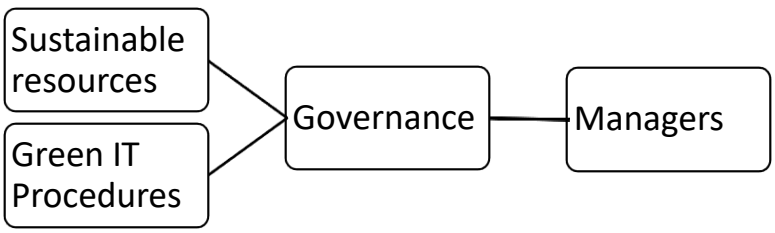

Figure 52. The final governance theme after EFA analysis

5.8.1.2.2 Social and Cultural

Several tests were applied to the social and cultural theme to minimise the factorability issues as the theme showed a cross-loading and low communalities contribution for several items, resulting in items being deleted. Table 73. Summary of the factor analysis results for Green Management, and shows one of the low communalities contributions as an example, the item coded “MSCcsr13” is highlighted in orange. In the reliability test for social and cultural items, Cronbach’s Alpha produced 0.752 for all items, score 0.659 in KMO, and ($p<0.0001$) for the Bartlett’s test for sphericity as shown in Table 66.

Reliability Statistics

Cronbach's Alpha	N of Items
.752	13

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.659
Bartlett's Test of Sphericity	Approx. Chi-Square	441.997
	df	78
	Sig.	0.000

Table 66. Cronbach's alpha, KMO and Bartlett's tests for Social and Cultural

The factorability test was conducted on thirteen items under three factors, and the SPSS accepted this approach as shown in Table 67 using principal component analysis. The items’ correlations result in a score above 0.45. Each factor’s contribution to total variance is 27.6, 16.6 and 15.2 respectively; the total variance results in 59.5%.

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.598	27.677	27.677	3.598	27.677	27.677	2.751	21.162	21.162
2	2.159	16.606	44.283	2.159	16.606	44.283	2.526	19.431	40.593
3	1.979	15.220	59.503	1.979	15.220	59.503	2.458	18.909	59.503

Table 67. The total variance results for Social and Cultural

The scree plot is shown in Figure 53. The elbow cross is just before one as the researcher forced SPSS to generate three factors; all the factors must be above one eigenvalue. In addition, the scree plot shows the first-factor contribution to the themes has an initial eigenvalue of 3.6, which has a high impact on the model.

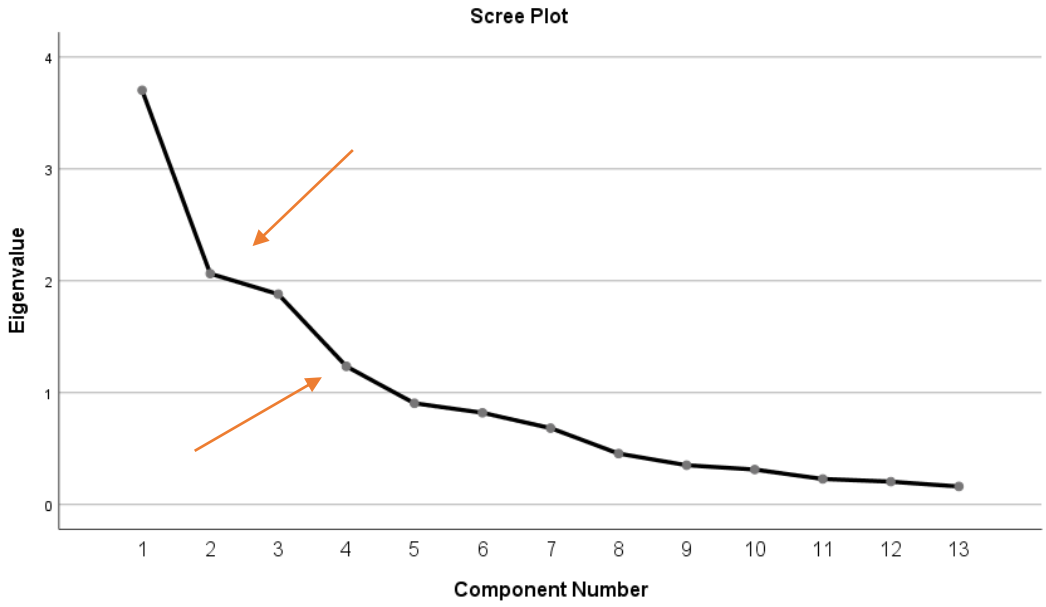

Figure 53. The elbow marking in the total component number the total variance results for Social and Cultural

The parallel test result yields three acceptable factors as shown in Table 68. All the first factors are accepted which match to current eigenvalue result.

Table 68. Parallel test for Social and Cultural theme

Factor	Actual Eigenvalue	Generated Eigenvalue	Decision
1	3.598	1.637650	Accepted
2	2.159	1.469416	Accepted
3	1.979	1.342519	Accepted
4	1.283	1.295418	Rejected

Table 69. Summary of the factor analysis results for Social and Cultural

		Factors Items	Item code	Factors 1	2	3	Communalities
Factors	Embedding sustainability	We have to Include sustainability in the school curriculum	MSCC14	.880			.783
		Green IT will help to change attitude towards the environment	MSCA11	.829			.760
		We have to Reduce paper usage in schools by utilizing technology	MSCC13	.731			.608
		Green IT will help to change the way we accomplish our tasks	MSCA12	.639			.589
	Sustainability awareness	People are not aware about Environment	MSS12		.864		.768
		People are not aware about Reducing paper wastage	MSS13		.739		.577
		People are not aware about Sustainability	MSS11		.671		.535
		The most-used media channel is Social media	MSS21		.611		.457
	Government responsibility	The government should force organizations to be responsible regarding social issues	MSCcsr21			.761	.617
		The government should raise public awareness about CSR through the schools	MSCcsr22			.737	.597
		Social media is the best way to change people's attitude toward sustainability	MSCA21			.604	.559
		Organizations need to be more aware of their corporate social responsibility (CSR)	MSCcsr13			.553	.229
		Green IT will help to change ideas about accepting new systems	MSCA13			.519	.566
		Cronbach Alpha test		**.803**	**.734**	**.787**	

Initially, the factor analysis retained four factors with low cross-loading with other items; the item deleted is shown in Table 69, then the researcher forced SPSS to adjust the number of factors to only three. The new result now matches the research requirement for EFA.

The results for the social and cultural theme with the newly named factors shown in Figure 54, the new factors are named embedding sustainability, sustainability awareness and government responsibility.

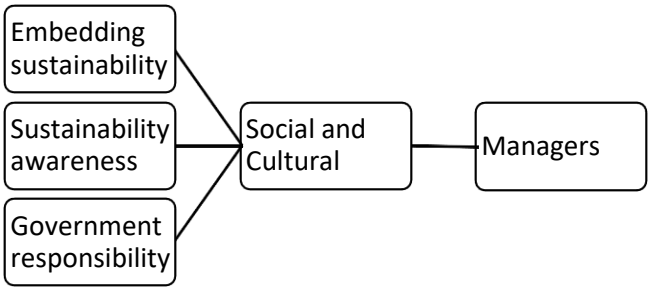

Figure 54. The final governance theme after EFA analysis

5.8.1.2.3 Green Management

In this theme, a number of factors were deleted due to their weak contribution to the model. The score of Cronbach's Alpha is .712, and KMO score is .686, which is acceptable for factorability. However, these need to be supported by results of the parallel tests, as well as scoring high communalities results, as shown in Table 70.

Table 70. Cronbach's Alpha, KMO and Bartlett's tests for Green Management

Reliability Statistics	
Cronbach's Alpha	N of Items
.723	11

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.686
Bartlett's Test of Sphericity	Approx. Chi-Square	442.364
	df	55
	Sig.	0.000

After principal component analysis, eleven items remained for the factorability test and resulted in three acceptable factors. As shown in Table 71, the items' correlation results are above 0.45. The total variance of each factor contribution in total variance is 33.1, 19.7 and 14.3 respectively; the total variance results in 67.2%.

Table 71. The total variance results for Green Management

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.649	33.174	33.174	3.649	33.174	33.174	2.893	26.300	26.300
2	2.174	19.764	52.938	2.174	19.764	52.938	2.403	21.845	48.145
3	1.573	14.303	67.241	1.573	14.303	67.241	2.101	19.096	67.241

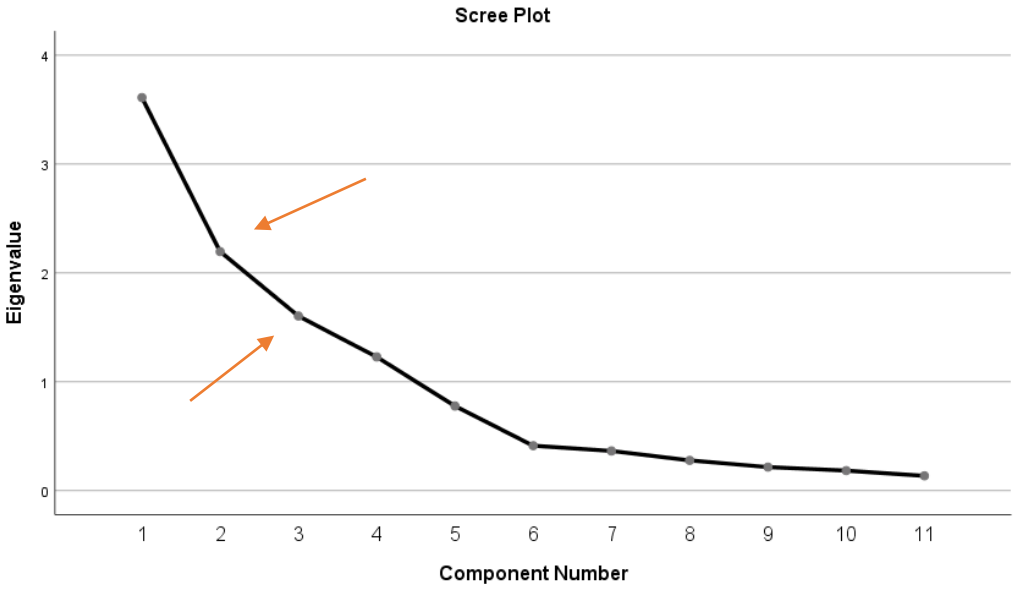

Figure 55. The elbow point marks the total component number for Green Management

The SPSS factor analysis forced to generate of three factors; the scree-plot elbow point is in the medial of number one, which means all the factors have an eigenvalue above one, as shown in Figure 55. The elbow point marks the total component number for Green Management. However, the parallel test accepts only three factors, which means the results support the three-factor results.

The scree plot in Figure 55 shows the elbow cross is just before one, as the system forced the generation of three factors, the entire factor must be above one eigenvalue, as shown in Table 72 for the parallel test.

Table 72. Parallel test for Green Management theme

Factor	Actual Eigenvalue	Generated Eigenvalue	Decision
1	3.649	1.557918	Accepted
2	2.174	1.398814	Accepted
3	1.573	1.269745	Accepted
4	1.171	1.188635	Rejected

Table 73 shows the results for the social green management theme. The new theme now has three factors named recycling management, sustainability policies and Green IT usage. The Cronbach's alpha for these factors is .845, .742 and .709 respectively.

Table 73. Summary of the factor analysis results for Green Management

		Factor Items	Item code	Factors 1	2	3	Communalities
Factors	Recycle management	Reusing our equipment in our work	MGMR12	.875			.790
		The government is applying the recycling program	MGMR21	.858			.829
		Recycle (for example paper and equipment) is in our organization	MGMR11	.774			.725
		The government is providing channels for accepting discarded machines	MGMR22	.765			.715
	Sustainability Policies	Organizations has developed a sustainable application in our systems	MGMEnv13		.888		.786
		Organizations uses several environment-friendly products	MGMEnv14		.822		.816
		Organizations encourages us to use environment-friendly products	MGMEnv15		.754		.576
		Organizations believes that price is not an issue if the product has better features	MGMEnv12		.450		.458
	Green IT usage	Cloud storage will be cheaper in the long run	MGMEco11			.789	.650
		The government is using email to contact them	MGMR23			.745	.520
		Cloud storage is easier to maintain	MGMEco12			.666	.543
		Cronbach Alpha test		**.845**	**.742**	**.709**	

The results for managers have three main themes: Governance, Social and Cultural, and Green management. The final structure of the items for Managers is shown in Figure 56. This is the final tree graph for the manager sections and related themes. In the following chapter, each of these factors will be discussed briefly.

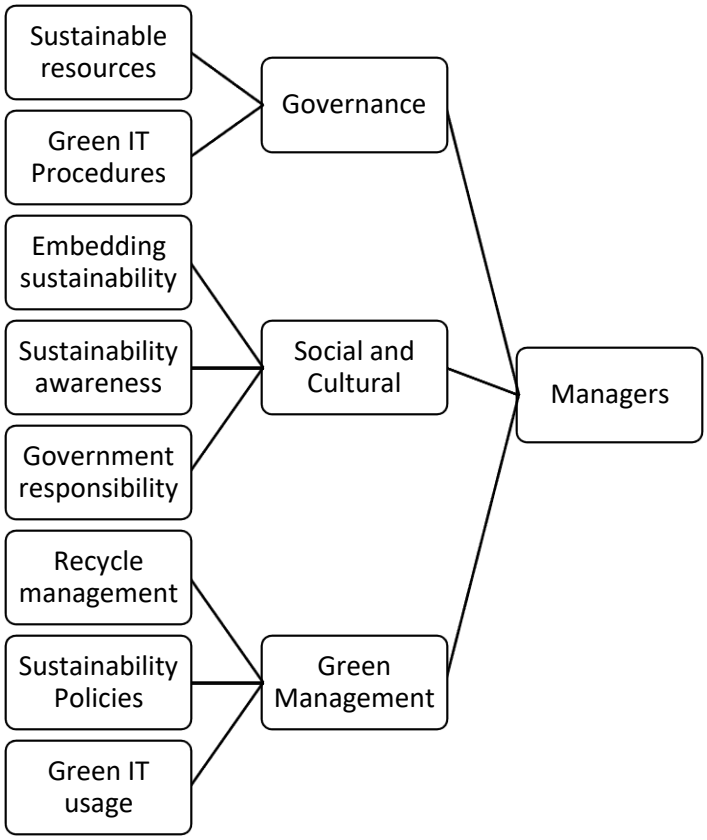

Figure 56. Manager's final factor analysis theme

5.8.2 IT personnel

This is the second section, which is intended to analyse and discuss the responses of the IT personnel who are either working in an IT department or have an IT background. This section asks IT personnel to respond to three themes: Social and Cultural, Green Management and Information Technology. The Information Technology theme is specifically intended for IT personnel because only they are required to give responses in this section.

5.8.2.1 Descriptive statistics

Table 74. Descriptive analysis for Social and Cultural in IT personnel section

	Statement	Mean	Std. Deviation
Social			
1	People are not aware about Sustainability	2.95	1.238
2	People are not aware about Environment	2.91	1.045
3	People are not aware about Reducing paper wastage	2.84	.931
4	The most-used media channel is Social media	2.38	.797
5	The most-used media channel is Television	2.51	.807
6	The most-used media channel is Newspapers	2.59	.948
Cultural			
7	We have to Separate bins to rubbish and recycle	2.21	.958
8	We have to Use only recycled paper in school books	2.12	.915
9	We have to Reduce paper usage in schools by utilizing technology	2.31	.901
10	We have to include sustainability in the school curriculum	2.62	.832
Acceptance			
11	Green IT will help to change attitude towards the environment	2.57	.850
12	Green IT will help to change the way we accomplish our tasks	2.55	.863
13	Green IT will help to change ideas about accepting new systems	2.41	.916
14	Social media is the best way to change people's attitude toward sustainability	2.20	.901
15	Social media is increase people's acceptance of a Green IT model	2.21	.860
Ethics			
16	Current job is helps me to change my mentality	2.32	.858
17	Current job helps me to apply what I learnt in my work to my personal life	2.48	.876
18	Current job is encouraging to change behaviour to become a better worker	2.58	.906
19	Companies that claim to be environment-friendly are attracting for purchasing	2.63	.995
20	Companies that claim to be environment-friendly are my preferred than are not	2.53	.928
Corporate Social Responsibility (CSR)			
21	Organisations are responsible regarding social issues	2.69	.954
22	Organisations have funded social and community projects	2.53	.875
23	Organisations need to be more aware of their corporate social responsibility(CSR)	2.33	.825
24	The government should force organizations to be responsible regarding social issues	2.23	.782

As shown in Table 74, the average mean for the Social and Cultural theme is close to agree frequently (M 2.49, StdD .908). The statement that was agreed with the least is that IT personnel think that people are not aware of sustainability (M 2.95, StdD 1.238). On the other hand, the most agreed-with statement is that IT personnel would recycle school books. Every year, the Ministry of Education distributes free textbooks to all GCC students.

In addition, most IT personnel think that social media is the best way to change people's

mindset regarding new technologies (M 2.20, StdD .901). In terms of awareness, IT personnel believe that people are aware of sustainability, the environment and paper wastage, as the awareness item in the social factor scored the highest on disagreement.

Table 75. Descriptive analysis of Green Management in IT personnel section

	Statement	Mean	Std. Deviation
	Recycle		
1	Recycle (for example paper and equipment) is in our organization	3.00	1.227
2	Reusing equipment in our work	2.72	.837
3	The government is applying the recycling program	2.53	.699
4	The government is providing channels for accepting discarded machines	2.32	.810
5	The government is using email to contact them	2.18	.947
	Economic		
6	Cloud storage will be cheaper in the long run	1.86	.833
7	Cloud storage is easier to maintain	2.00	.833
8	Updating and upgrading computers is very costly	2.67	.775
9	Updating and upgrading computers is takes a long time	2.61	.810
10	Updating and upgrading computers is makes it hard to destroy old data	2.54	.972
	Environmental		
11	Organizations is concerned about purchasing environment-friendly products	2.38	.975
12	Organizations believe that price is not an issue if the product has better features	2.34	.960
13	Organizations uses several environment-friendly products	2.70	.899
14	Organizations have developed a sustainable application in our systems	2.59	1.028
15	Organizations encourages us to use environment-friendly products	2.61	1.134
	Average	**2.47**	**0.916**

The descriptive analysis for green management is shown in Table 75. The analysis shows that IT personnel believe that their organisation is not applying a recycling system (M 3.00, StdD 1.227). However, IT personnel believe that cloud storage is cheaper for their organisation in the long run (M 1.86, StdD .833) although, usually, they do not know much about cloud computing and its benefits. “Cloud computing presents an additional opportunity for reducing energy use and costs” (Harmon and Moolenkamp, 2012).

The overall average mean and standard deviation for green management is (M 2.47, StdD 0.916), which means IT personnel are close to agreement on green management statements. In the recycle factor, a statement “Reusing our equipment in our work” score (M 2.72, StdD .837), and a statement for the environmental factor “Organizations uses several environment-friendly products” scores (M 2.7, StdD .899), which means IT personnel are closer to nature in terms of their sustainable IT departments in GCC countries.

Table 76. Descriptive analysis for Information Technology in IT personnel section

	Statement	Mean	Std. Deviation
Smart Technology			
1	Technologies that we are using are very useful for our business	2.74	1.226
2	Technologies that we are using in my organization are increases the efficiency of our business operations	2.66	.906
3	Technologies that we are using in my organization are not needs to be improved	2.63	.922
4	We are using all type of technologies in my organization (computer, phone, tablet)	2.24	.798
5	In my organization we need to upgrade our technology	2.17	.833
Architecture			
6	In our data centre – we have a heat management system	2.03	.928
7	In our data centre – we consider the environment when extending our operations	2.11	.911
8	In our data centre – we use an application to reduce power consumption	2.41	.916
9	In our data centre – we use Green Cloud	2.80	.805
10	In our data centre – we focus on quality – nothing else	2.68	.914
Hardware			
11	When our data centre requires more storage, I would prefer to - Increase storage capacity (traditional method)	2.57	.885
12	When our data centre requires more storage, I would prefer to - Use Cloud solutions	2.36	.830
13	When our data centre requires more storage, I would prefer to - Remove old data to make room for the new	2.33	.958
14	When our data centre requires more storage, I would prefer to - Change the recovery method	2.23	.964
15	Storing business data via reputable companies - Lead to data being stolen or not saved	2.18	.849
16	Storing business data via reputable companies - mean that only non-sensitive data could be stored	2.20	.912
Software			
17	Using a virtual machine - Is difficult compared with regular computers	2.19	.841
18	Using a virtual machine - Has saved me many times (data stored in the Datacentre)	2.30	.854
19	Installing a virtual machine - Is very difficult	2.42	.927
20	Installing a virtual machine - Requires experts	2.36	.948
21	We are using Email as the primary method to finish our work	2.16	.806
Training			
22	In order to develop our skills, our organization - Provides very useful training for self-learning	2.38	.833
23	In order to develop our skills, our organization - Has a library and training sessions rooms	2.35	.897
24	In order to develop our skills, our organization - Provide training on request	2.25	.898
25	My organization - Offers various awareness programs via our IT team (for example provide awareness to prevent hacking)	2.25	.829
26	My organization - Ensures that we are aware of the risks associated with data use by a (team/department) for computer security	2.19	.829
Support			
27	Our support team is - Well trained for most of the technical issues	2.31	.744
28	Our support team is - They solve the problem as fast as they can	2.35	.816
29	Our support team is - They do have different people for different issues	2.51	.898
30	Our support team is - They provide classes for training new systems	2.41	1.037

Practice			
31	Using computer metrics for our datacentre (for example power management) - is a powerful tool	2.36	.930
32	Using computer metrics for our datacentre (for example power management) - give us more control of our machines	2.23	.932
33	In my organization - We use tools to control temperature in the datacentre	2.09	.772
34	In my organization - We monitor power usage in our organization	2.22	.779
35	In my organization - We have never had any problem with using metrics tools	2.28	.916
	Average	2.34	.886

The Information Technology descriptive analysis presented in Table 76, shows various outcomes, as the items were answered by only IT personnel and have the greatest number of elements. For the smart technologies factor, the most agreed-with statement is that IT personnel believe that their current technologies need to be upgraded (M 2.17, StdD .833).

For the architecture factors, IT personnel agreed that the data centres in GCC countries already have a heat management system (M 2.03, StdD .928). However, in regard to the hardware factor, the most agreed-with statement is that IT personnel believe that storing data in well-known companies might lead to them being stolen or not saved (M2.18, StdD.849). Overall, the average for the most common responses to the Information technology theme is (M 2.34, StdD .886), which indicates that IT personnel are close to concurring on this item.

5.8.2.2 EFA IT personnel analysis

The aim of this section is to analyse the survey data of IT personnel using the exploratory factor analysis method.

5.8.2.2.1 Social and cultural

The factorability test using EFA for the social and cultural theme resulted in the deletion of various statements due to low either commonalities or cross-loading scores. Figure 57 shows that the test introduced four factors for this section. The test measured the reliability of items, the theme scores 0.784 for all the 18 items that accepted, and the KMO and Bartlett's test scored 0.631, ($p<0.0001$) which is acceptable result.

Reliability Statistics

Cronbach's Alpha	N of Items
.784	18

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.631
Bartlett's Test of Sphericity	Approx. Chi-Square	792.747
	df	153
	Sig.	0.000

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.118	22.876	22.876	4.118	22.876	22.876	3.294	18.301	18.301
2	2.703	15.014	37.890	2.703	15.014	37.890	2.492	13.842	32.143
3	2.017	11.207	49.097	2.017	11.207	49.097	2.368	13.157	45.300
4	1.533	8.516	57.613	1.533	8.516	57.613	2.216	12.313	57.613

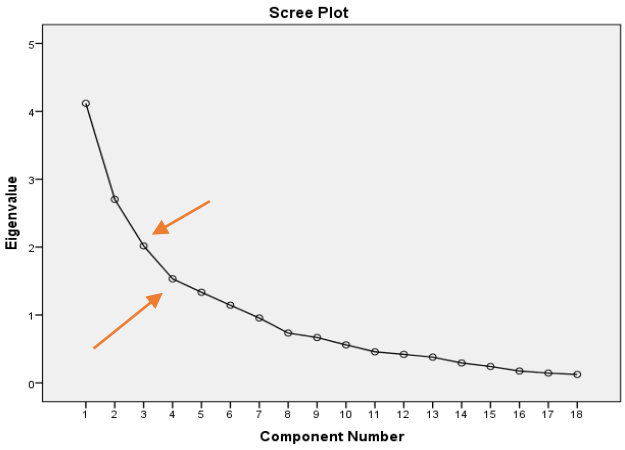

Figure 57. EFA result for Social and Cultural section

Table 77 shows the results of the analysis indicating factorability using principal component analysis run on 18 items. The factor correlations accept all items that score above 0.45. Also, as shown in Figure 57, the results are four factors with a variance contribution of 22.8%, 15%, 11.2%, and 8.5% respectively. The total variance is 57.6% which indicates acceptable results, and scree plots show the entire elbow curve for the eigenvalues.

Table 77. Summary of the factor analysis results

Factors		Factors Items	Factors			
			1	2	3	4
Factors	Sustainability Awareness	People are not aware about Environment	.902			
		People are not aware about Reducing paper wastage	.823			
		People are not aware about Sustainability	.782			
		The most-used media channel is Social media	.772			
		We have to Include sustainability in the school curriculum	.597			
	Embedding Sustainability	Companies that claim to be environment-friendly are my preferred than are not		.719		
		Companies that claim to be environment-friendly are attracting for purchasing		.674		
		We have to Use only recycled paper in school books		.590		
		Organisations are responsible regarding social issues		.585		
		We have to Reduce paper usage in schools by utilizing technology		.557		
	Sustainability influence	The most-used media channel is Newspapers			.839	
		The most-used media channel is Television			.811	
		We have to Separate bins to rubbish and recycle			.604	
	Government responsibility	The government should force organizations to be responsible regarding social issues				.781
		The government should raise public awareness about CSR through the schools				.713
		Organisations need to be more aware of their corporate social responsibility (CSR)				.530
		Social media is the best way to change people's attitude toward sustainability				.490
		Social media is increase people's acceptance of a Green IT model				.482
		Cronbach Alpha test	.853	.709	.746	.718

As shown in Table 78, the parallel test accepted only four factors, whose eigenvalues show that they are acceptable for further analysis.

Table 78. Parallel test for Social and Cultural theme

Factor	Actual Eigenvalue	Generated Eigenvalue	Decision
1	4.118	1.983547	Accepted
2	2.703	1.768205	Accepted
3	2.017	1.580550	Accepted
4	1.533	1.477888	Accepted
5	1.335	1.364918	Rejected

The four factors that are shown in Table 77 named “sustainability awareness” is the most items related to the people awareness regarding sustainability. The second factor, "Embedding Sustainability," was how sustainability could be transformed into the social sector. “Sustainability influence” is the third factor, as the cross-loading items related to how sustainability influences people using the media. Lastly, the fourth factor is “Government responsibility”, as the items related to how government will act to change the current society to be more sustainable.

5.8.2.2.2 Green Management

In this theme, a number of items were deleted due to their weak contribution to the model. The overall Cronbach's Alpha score is .777, and KMO is .702, which is a good score for factorability, as well as scoring high communalities results, as shown in Figure 58.

The data was analysed using principal component analysis. There were eleven items reined to the factorability test results in accepting two factors. As shown in Figure 58, the items’ correlations are all above 0.45. The total variance for each factor contribution in total variance is 40.6% and 22% respectively, giving a total of 62.2% in total.

Reliability Statistics

Cronbach's Alpha	N of Items
.777	8

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.702
Bartlett's Test of Sphericity	Approx. Chi-Square	315.148
	df	28
	Sig.	.000

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.250	40.626	40.626	3.250	40.626	40.626	2.727	34.090	34.090
2	1.767	22.093	62.719	1.767	22.093	62.719	2.290	28.629	62.719

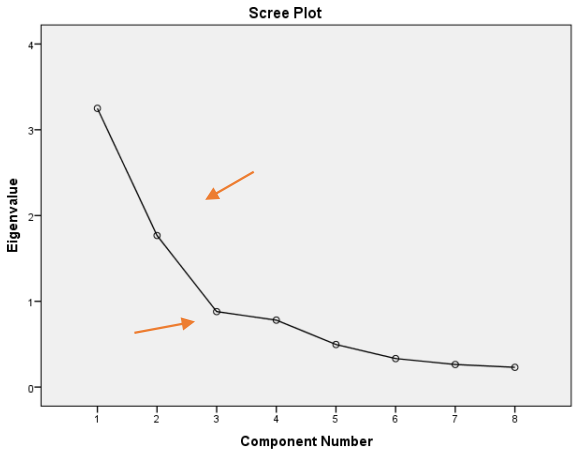

Figure 58. EFA result for Green management for IT personnel section

The SPSS only two factors to be chosen because at the start it gives a low number of items with low communities. The scree plots the elbow point shown Figure 58 in the medial of number one, which means all the factors score above one in eigenvalue, as shown in Figure 58. In addition, the parallel test accepts two factors as shown in Table 79, which means the results support the two factoring results.

Table 79. Parallel test for Green Management theme

Factor	Actual Eigenvalue	Generated Eigenvalue	Decision
1	3.250	1.593176	Accepted
2	1.767	1.364600	Accepted
3	.880	1.205935	Rejected

Table 80 shows the factor loading for the proposed two factors. The first factor is named "Recycled management", as most items related to managing the recycling using different methods. The second factor is named "Green IT usage" as the items related to the way that organisations can use Green IT.

Table 80. Summary of the factor analysis results of Green management for IT personnel

		Factors Items	Factors	
			1	2
Factors	Recycle management	Reusing our equipment in our work	.853	
		Recycle (for example paper and equipment) is in our organization	.846	
		Updating and upgrading computers is very costly	.704	
		The government is applying the recycling program	.678	
		Updating and upgrading computers is takes a long time	.521	
	Green IT usage	Updating and upgrading computers is makes it hard to destroy old data		.848
		Organizations is concerned about purchasing environment-friendly products		.831
		Organizations believes that price is not an issue if the product has better features		.800
		Cronbach Alpha test	.785	.791

5.8.2.2.3 Information Technology

For the information technology section which contained the greatest number of items, t several factorability tests were conducted to increase the reliability and reduce the cross-loading factors. The results have shown that 23 items were accepted and categorised under four factors as shown in Figure 59. The Cronbach's Alpha reliability test for this section yielded a score of 0.808 for all the items, and score 0.613 in KMO, and ($p<0.0001$) for the Bartlett's test of sphericity, which means the entire factor is eligible for EFA.

Reliability Statistics

Cronbach's Alpha	N of Items
.808	23

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.613
Bartlett's Test of Sphericity	Approx. Chi-Square	1200.847
	df	253
	Sig.	0.000

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.694	20.407	20.407	4.694	20.407	20.407	3.903	16.969	16.969
2	3.031	13.179	33.586	3.031	13.179	33.586	3.104	13.497	30.466
3	2.445	10.629	44.215	2.445	10.629	44.215	2.788	12.122	42.588
4	2.278	9.905	54.120	2.278	9.905	54.120	2.652	11.531	54.120

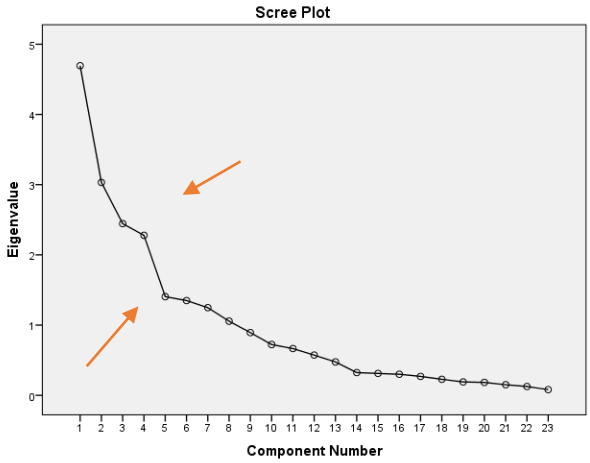

Figure 59. EFA result for Information Technology of IT personnel section

As shown in Figure 59, the factor contribution variance for each factor score 20.4%, 13.1%, 10.6% and 9.9% from total variance; which means the total variance for the four factors represents 54.1% of the overall variance. In the scree plot shown in Figure 59, the elbow cross is just before number 2, as the system was forced to generate four factors, and all the factors must be above one eigenvalue.

For the parallel test, only four factors were accepted which supports the results of the reliability test as shown in Table 81.

Table 81. Parallel test for Information Technology theme

Factor	Actual Eigenvalue	Generated Eigenvalue	Decision
1	4.694	2.162456	Accepted
2	3.031	1.917757	Accepted
3	2.445	1.774822	Accepted
4	2.278	1.628343	Accepted
5	1.405	1.521313	Rejected

Table 82 shows the factor loadings for the Information Technology theme, four loading factors for 23 items are available for this theme. The first factor is “sustainable data centre”, as the factor loading focuses on the data centre items in term of virtual machines, and cloud solutions. The second factor is named “employees’ skills development”, as the factor loading related to sustainable development for the current employees. The third factor is named “automated sustainability”, as the items related to the computing metrics for the IT support team. The last factor is named “cloud computing”, as the items relating to cloud computing in practice and business.

Table 82. Summary of the factor loading results for the Information Technology theme

Factors		Factors Items	Factors			
			1	2	3	4
Factors	Sustainable data centre	When our data centre requires more storage, I would prefer to - Increase storage capacity (traditional method)	.793			
		In our data centre - Focus on quality – nothing else	.764			
		Installing a virtual machine - Is very difficult	.665			
		Installing a virtual machine - Requires experts	.652			
		Technologies that we are using in my organization are increases the efficiency of our business operations	.622			
		Technologies that we are using are very useful for our business	.616			
		We are using Email as the primary method to finish our work	.550			
		When our data centre requires more storage, I would prefer to - Use Cloud solutions	.528			
	Employees skills development	When our data centre requires more storage, I would prefer to - Change the recovery method		.757		
		When our data centre requires more storage, I would prefer to - Remove old data to make room for the new		.658		
		Storing business data via reputable companies - Lead to data being stolen or not saved		.622		
		In order to develop our skills, our organization - Has a library and training sessions rooms		.584		
		In order to develop our skills, our organization - Provides very useful training for self-learning		.582		
		In order to develop our skills, our organization - Provide training on request		.507		
	Automated sustainability	Our support team is - They provide classes for training new systems			.914	
		Using computer metrics for our datacentre (for example power management) - is a powerful tool			.887	
		Using computer metrics for our datacentre (for example power management) - give us more control of our machines			.700	
		Our support team is - They do have different people for different issues			.616	
	Cloud computing	Using a virtual machine - Is difficult compared with regular computers				.850
		Storing business data via reputable companies - mean that only non-sensitive data could be stored				.794
		Using a virtual machine - Has saved me many times (data stored in the Datacentre)				.679
		In our data centre - Have a heat management system				.489
		In my organization we are needs to be upgraded our technology				.482
		Cronbach Alpha test	**.817**	**.742**	**.813**	**.744**

The last themes for IT personnel are shown in Figure 60 which shows all the themes sections and their factors. Therefore, the tree has three themes: Information Technology, Social and Cultural and Green Management. Each one of these is connected to the factors newly generated from EFA.

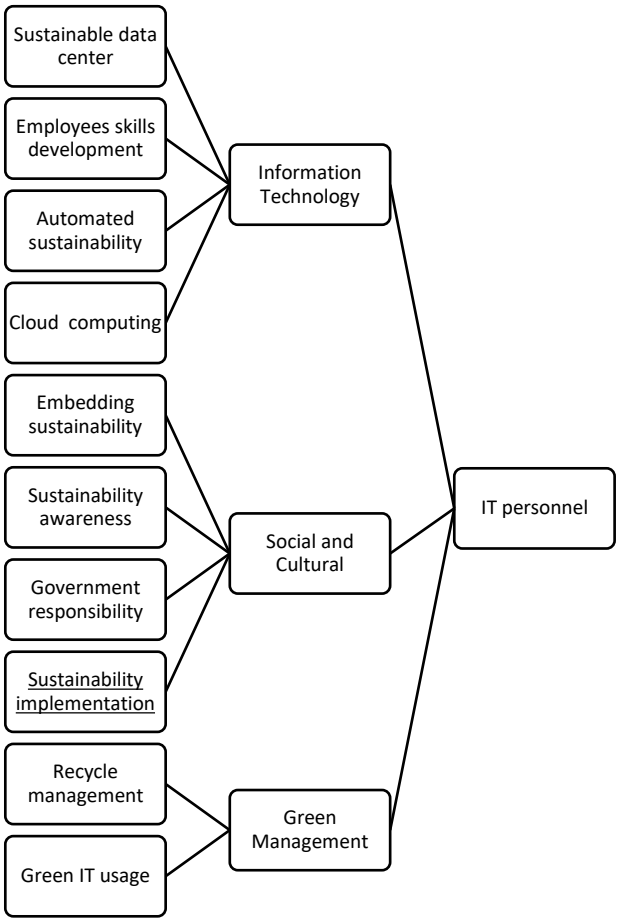

Figure 60. Themes and factors for IT personnel section

5.8.3 Non-IT personnel

This section analyses data obtained from non-IT participants; this section has the greatest number of answers. The non-IT personnel were required to provide answers for two themes, Social and Cultural and Green Management.

5.8.3.1 Descriptive statistics

Table 83. Descriptive analysis for Green Management in the non-IT personnel section

	Statement	Mean	Std. Deviation
Social			
1	People are not aware about Sustainability	2.52	1.190
2	People are not aware about Environment	2.53	1.095
3	People are not aware about Reducing paper wastage	2.65	1.011
4	The most-used media channel is Social media	2.11	.813
5	The most-used media channel is Television	2.27	.885
6	The most-used media channel is Newspapers	2.42	1.019
Cultural			
7	We have to Separate bins to rubbish and recycle	1.98	.812
8	We have to Use only recycled paper in school books	2.02	.827
9	We have to Reduce paper usage in schools by utilizing technology	2.23	.899
10	We have to include sustainability in the school curriculum	2.47	.845
Acceptance			
11	Green IT will help to change attitude towards the environment	2.26	.796
12	Green IT will help to change the way we accomplish our tasks	2.28	.886
13	Green IT will help to change ideas about accepting new systems	2.31	.926
14	Social media is the best way to change people's attitude toward sustainability	2.04	.810
15	Social media is increase people's acceptance of a Green IT model	2.16	.896
Ethics			
16	Current job is helps me to change my mentality	2.12	.785
17	Current job helps me to apply what I learnt in my work to my personal life	2.30	.888
18	Current job is encouraging to change behaviour to become a better worker	2.46	.950
19	Companies that claim to be environment-friendly are attracting for purchasing	2.22	.848
20	Companies that claim to be environment-friendly are my preferred than are not	2.32	.867
Corporate Social Responsibility (CSR)			
21	Organisations are responsible regarding social issues	2.35	.910
22	Organisations have funded social and community projects	2.36	.948
23	Organisations need to be more aware of their corporate social responsibility (CSR)	2.26	.939
24	The government should force organizations to be responsible regarding social issues	2.00	.760
25	The government should raise public awareness about CSR through the schools	2.10	.902
	Average	**2.26**	**0.90**

Table 83 shows the descriptive statements in the Social and Cultural section for non-IT personnel; the number of participants in this table is 454, which is the greatest number of responses for this research. In the social factor, the most agreed-with statement was "The most-used media channel is social media" (M 2.11, StdD .813), and for the cultural factor, the most agreed statement was "We have to separate bins to rubbish and recycle" (M 1.98,

StdD.812). Which means non-IT personnel believe that social media can help to change the current everyday activities; people can for instance, separate recyclables in separate bins. “Culture is considered as an important potential factor affecting commitment to sustainability” (Reilly and Weirup 2011, 4). The average answer for social and cultural section is (M 2.26, StdD .90), which means non-IT personnel are close to agreeing in terms of social and cultural factors.

Table 84. Descriptive analysis for Green Management in non-IT personnel section

	Statement	Mean	Std. Deviation
Recycle			
1	Recycle (for example paper and equipment) is in our organization	2.47	1.156
2	Reusing our equipment in our work	2.39	.871
3	The government is applying the recycling program	2.09	.773
4	The government is providing channels for accepting discarded machines	2.12	.925
5	The government is using email to contact them	2.26	.990
Economic			
6	Cloud storage will be cheaper in the long run	1.98	.770
7	Cloud storage is easier to maintain	2.06	.864
8	Updating and upgrading computers is very costly	2.37	.913
9	Updating and upgrading computers is takes a long time	2.29	.863
10	Updating and upgrading computers is makes it hard to destroy old data	2.33	.924
Environmental			
11	Organizations is concerned about purchasing environment-friendly products	2.09	.796
12	Organizations believes that price is not an issue if the product has better features	2.16	.876
13	Organizations uses several environment-friendly products	2.37	.913
14	Organizations has developed a sustainable application in our systems	2.52	.908
15	Organizations encourages us to use environment-friendly products	2.61	1.013
	Average	**2.27**	**0.903**

Table 84 shows the statements in the green management section for non-IT personnel, the most agreed-with item for the recycle factor was that the government is applying a recycling program (M 2.09, StdD .773). This response was due to most GCC countries starting to work on achieving their future visions, and all the visions include the digital transformation element. For the economic factor, the most agreed-with statement was that cloud storage would be cheaper in the long-run (M 1.98, StdD .770). Interestingly this mirrors the responses from the IT personnel. For the environmental factor, non-IT personnel agreed that the organisations are considering the environment when purchasing (M 2.09, StdD .796). Lastly, the average results for statements frequently made in the green management section are (M 2.27, StdD .903).

5.8.3.2 EFA of non-IT personnel data

The aim of this section is to analyse the survey data of non-IT personnel using the exploratory factor analysis method.

5.8.3.2.1 Social and Cultural

Several tests were conducted for the Social and Cultural theme, generating three factors and 12 items in total. Several items were deleted during this process due to either low communalities contribution or low factor loading. Figure 61 shows the overall reliability test score of 0.713 for the Cronbach's Alpha test, score 0.601 in KMO, and ($p<0.0001$) for the Bartlett's test of sphericity.

Reliability Statistics

Cronbach's Alpha	N of Items
.713	12

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.601
Bartlett's Test of Sphericity	Approx. Chi-Square	2078.114
	df	66
	Sig.	0.000

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.030	25.246	25.246	3.030	25.246	25.246	2.610	21.754	21.754
2	2.086	17.381	42.628	2.086	17.381	42.628	2.116	17.629	39.383
3	1.638	13.651	56.279	1.638	13.651	56.279	2.028	16.896	56.279

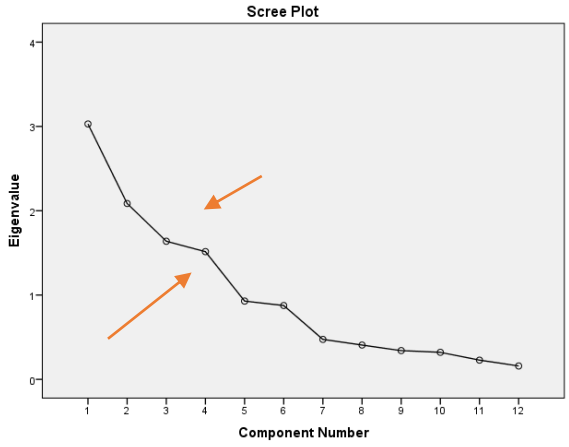

Figure 61. EFA result for non-IT personnel for Social and Cultural section

As shown in Figure 61, using principal component analysis, the factorability test produces twelve items and only three factors are accepted. The total variance for all accepted factors is 56.2% from overall variance, and the factors have values of 25.2%, 17.3% and 13.6% respectively. The system was forced to generate three factors using SPSS. All the factors must be above one eigenvalue; the scree plot elbow shows that all are above one as shown in Figure 61.

Several parallel tests were conducted, and the result was accepted for all factors. However, due to the high response rate, this test was unnecessary, as it is normally used for research with a smaller sample. The results of the parallel test are shown in Table 85.

Factor	Actual Eigenvalue	Generated Eigenvalue	Decision
1	3.030	1.334409	Accepted
2	2.086	1.241499	Accepted
3	1.638	1.186344	Accepted

Table 85. Parallel test of Social and Cultural theme for non-IT personnel

As shown in Table 86, the three factors for this theme are named firstly “sustainability awareness” as the most items related to the people awareness regarding sustainability. The second factor is named “government responsibility”, as the items related to how government could act to change the current social activity to be more sustainable. The third factor is named “Embedding Sustainability”, as the items related to how society could integrate sustainability in their current activities.

Table 86. Summary of the factor loading results for Social and Cultural in non-IT personnel data

		Factors Items	Factors loading		
			1	2	3
Factors	Sustainability Awareness	People are not aware about Environment	.878		
		People are not aware about Reducing paper wastage	.808		
		People are not aware about Sustainability	.753		
		The most-used media channel is Social media	.651		
	Government responsibility	Social media is the best way to change people's attitude toward sustainability		.859	
		Green IT will help to change ideas about accepting new systems		.856	
		Green IT will help to change the way we accomplish our tasks		.506	
		Social media is increase people's acceptance of a Green IT model		.454	
	Embedding Sustainability	Green IT will help to change attitude towards the environment			.760
		We have to Include sustainability in the school curriculum			.708
		The government should force organizations to be responsible regarding social issues			.645
		Organizations need to be more aware of their corporate social responsibility (CSR)			.608
		Cronbach Alpha test	**.795**	**.722**	**.734**

5.8.3.2.2 Green Management

For the green management theme, several items are removed due to their weak contribution in either commonalities or factor loading score. The Cronbach's Alpha test score is .613 and KMO reliability test value is .614 which is an acceptable score for factorability as this section has high number of participants, as shown in Figure 62. Using principal component analysis, they were eight items reined to the factorability test, and resulted in two factors being accepted. The total variance for accepted factors is 56%, and each factor's contribution is 30.1% and 25.9% respectively.

Reliability Statistics

Cronbach's Alpha	N of Items
.613	8

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.614
Bartlett's Test of Sphericity	Approx. Chi-Square	1102.386
	df	28
	Sig.	0.000

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.410	30.129	30.129	2.410	30.129	30.129	2.408	30.095	30.095
2	2.070	25.869	55.998	2.070	25.869	55.998	2.072	25.904	55.998

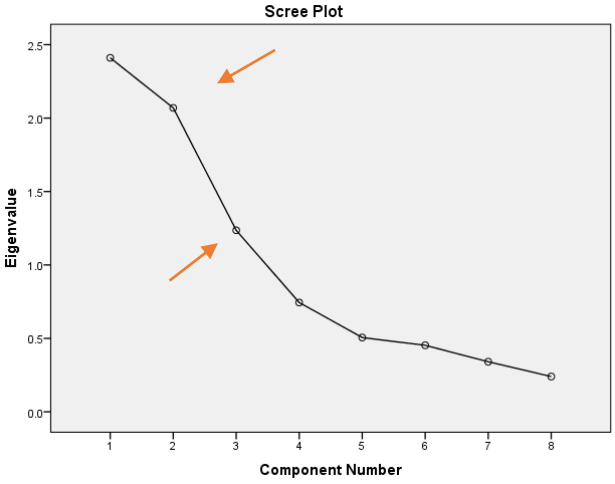

Figure 62. EFA result of Green management for non-IT personnel section

As the system is forced to generate two factors, all the factors must be above one eigenvalue; results in the scree plot elbow are all above one as shown in Figure 62. The parallel test is accepting all the forced factors, as shown in Table 87.

Table 87. Parallel test of green management for non-IT personnel section

Factor	Actual Eigenvalue	Generated Eigenvalue	Decision
1	**2.410**	**1.272504**	**Accepted**
2	**2.070**	**1.168605**	**Accepted**

Table 88 shows the factor loading for the proposed two factors, the first factor named “Recycle management”, as most items related to managing the recycling using different methods. The second factor is named “sustainability policies” as the items related to managing the usage of Green IT.

Table 88. Summary of the factor loading results of Green Management for non-IT personnel

		Factors Items	Factors loading	
			1	2
Factors	**Recycle management**	Reusing our equipment in our work	.840	
		Recycle (for example paper and equipment) is in our organization	.767	
		The government is applying the recycling program	.706	
		Cloud storage will be cheaper in the long run	.614	
	sustainability policies	The government is providing channels for accepting discarded machines		.748
		The government is using email to contact them		.674
		Organizations uses several environment-friendly products		.561
		Organizations has developed a sustainable application in our systems		.551
		Cronbach Alpha test	.688	.712

The final section's themes for non-IT personnel are shown in Figure 63. The tree has two themes Social and Cultural, and Green Management. Each one of these themes is connected to the factors newly generated by EFA.

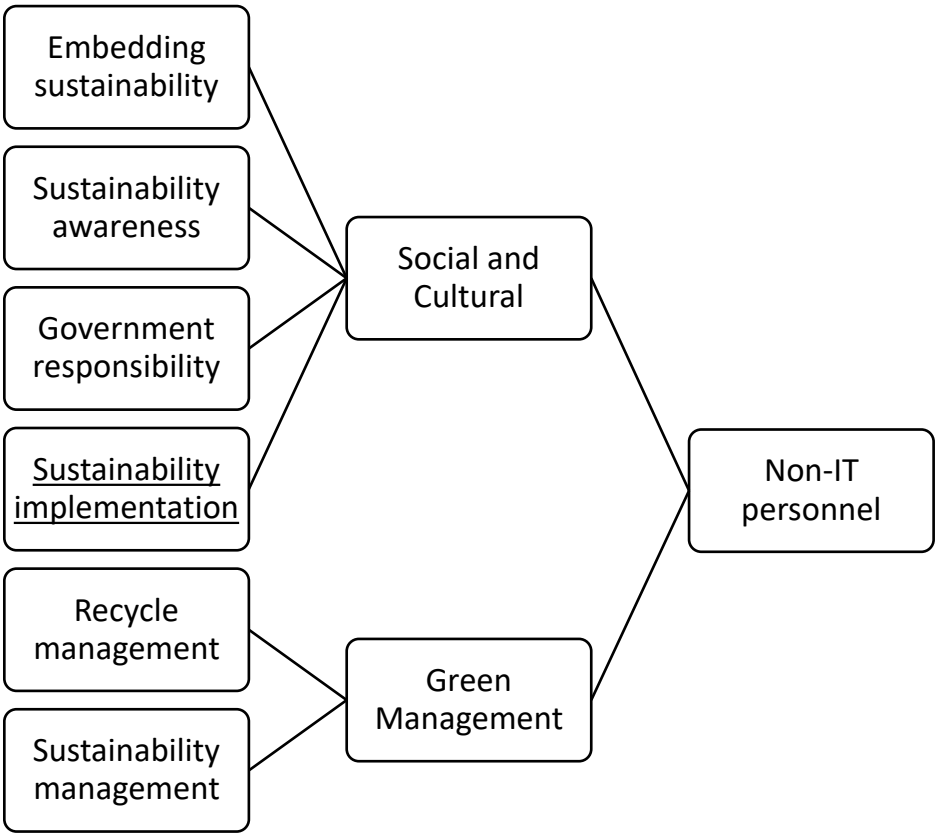

Figure 63. Themes and factors for the non-IT personnel section

5.9 The survey findings and discussion

The collection of survey data is the final stage for this research. After the interview stage, minor changes were made to the model. The main change was the addition of a developing layer to the overall model and the naming and ordering of some factors. However, the results obtained from the survey significantly changed the model, especially in terms of the factor number and order as shown in Figure 64. Therefore, the next section will discuss the changes and results in detail.

This research contributes to several activities in Green IT. The ultimate commitment lies in the creation of a Green IT model of transparency, processes and drivers for big, large private and public entities from the critical needs of GCC countries. Through discussing Green IT in the sense of major GCC businesses, the Green IT concept often refers to a literary demand to further understand Green IT in action.

The concept is also the first to be established in the context of a GCC developing country with high IT dependence and environmental weaknesses, namely the GCC. The governments of the GCC are committed to making the country both a leading ICT center and a prime example of environmental sustainability. Without collaboration, this cannot be achieved; hence, businesses need to maximize the use and sustainable development. The model assists key GCC businesses to use IT strategically (including environmentally sustainable practices) and provides grounds for areas of improvement discussed in section 6.2.

5.9.1 Managers

The EFA result for the governance theme yielded two factors: sustainable resources and Green IT procedures. In regard to the sustainable resources factor, the survey analysis shows that managers believe that organisations should make regulations to save natural sources and use sustainable materials in their work. In addition, the survey shows that a stronger connection is required between managers and the use of Green IT in business in term of profitability.

On the other hand, for the Green IT procedure factor, the survey shows that managers believe that the introduction and implementation of Green IT concepts in their organisations will reduce time and costs. In addition, managers are indicating that all governments in GCC countries should pass laws to limit CO_2 emissions, which is currently not the case in most of the GCC nations. However, a sustainable project will help to speed up the process of making and enforcing regulations and raising the awareness of sustainability among employees. “The GCC has the potential to become an economic power in terms of renewable energy and what

happens at Masdar will be an important milestone for the broader GCC to focus on renewable energy and sustainability policy issues" (Ramady, 2012).

The analysis of the data for the social and cultural theme generated three factors under twelve items, the factors named as embedded sustainability, sustainability awareness and government responsibility. The embedding sustainability factors indicate managers' attitudes towards sustainable activities in their daily lives. For example, the highest item loading for this factor was "*We have to Include sustainability in the school curriculum*" and "*Green IT will help to change attitude towards the environment*", which means they strongly believe that change starts in the school, and that Green IT concepts will be well-accepted by society if applied appropriately. "GCC such as Saudi Arabia have sponsored e-learning programmes via teacher training, renewal of school curriculum and the general educational climate of schools" (Ramady, 2012).

For the "Sustainability awareness" factor, managers stated that some sustainable practices were applied in their organisations, and that these technologies made their job easier. In addition, managers commented that they are encouraging their employees to use sustainable technology. However, managers believe that the cost of applying these technologies is an issue, which might prevent their adoption by some companies.

5.9.2 IT personnel

Several observations can be made from the accountabilities documented in the final IT personnel section. For example, for the social and cultural theme, the IT personnel section has four factors. The new factor is named "Sustainability influence", as IT personnel are able to adapt quickly to new technology changes. This aligns with Tarhini, Hone, and Liu's (2015) research which surveyed 1173 university students from two different universities in Lebanon and England. The results show that the students with a technology background accept the new local technologies in the university and help those students with no technology background. Likewise, in the Green management section, the IT personnel data shows only two factors; the "Sustainability Policies" factor was not identified by the analysis.

In addition, the final IT personnel section shows that the Information Technology theme has four factors; only IT personnel were required to respond to items in this section. The first factor, "Sustainable data centre", shows that IT personnel are aware of the technologies that are being used in their data centre; also, they believe that installing Green IT technologies such as virtual machines and cloud systems, is more efficient and has cost benefits for the organisations. "The most important and economical effort in sustainable data centre design is

reducing energy use" (Weihl *et al.*, 2011). The Information Technology section is not isolated from other two sections, since IT personnel play a key role in a company's finances, particularly in terms of appropriate decision-making. Despite different factors for green management themes in each section, the green management theme for the IT personnel section has two factors: recycle management and Green IT usage.

Overall, the IT personnel section has the greatest number of questions compared to the sections for Managers and non-IT personnel. Some of the participants have good knowledge about Green IT and sustainability. This knowledge was acquired through studies abroad or the participants' companies conducted awareness programmes. A survey conducted by Susilawati and Al Surf (2011) regarding the challenges facing sustainable housing in Saudi Arabia, produced a list of the main concerted actions that stakeholders can take in order to develop sustainability concepts in developing countries. Some of these considerations are: "Raise awareness among government officials and politicians", "Provide funding to support emerging businesses and innovative technologies" and "Adopt a regulatory framework for sustainable construction".

5.9.3 Non-IT personnel

Non-IT personnel responded to two themes: social and cultural, and green management. SPSS generated three factors for the social and cultural theme: "Sustainability Awareness", "Government responsibility" and "Embedding Sustainability". The survey gives indications that non-IT personnel do have a lack of knowledge of Green IT and sustainability compared to IT personnel and managers. In the Sustainability awareness factors, non-IT personnel believe that people in GCC countries are not aware of the sustainability concepts and most efficient social way to access the sustainability concepts for the social in GCC region by social media. In addition, the data shows that non-IT personnel want governments in the GCC region to take more responsibility by applying basic sustainability policies and taking measures to raise awareness, especially in regard to recycling. Therefore, the Government responsibility factor focuses on the government responsibility for the design and implementation of a suitable Green IT framework using social media for awareness and regulations.

On the other hand, the Embedding sustainability factor indicates how non-IT personnel are embedding the sustainability on the regular people living in GCC regions. For instance, non-IT personnel believe that including the sustainability concepts in the school curriculum will help to make people aware of Green IT. In addition, non-IT personnel believe that organisations in GCC countries should start to implement CSR programs. A study by Khasharmeh and Desoky (2013) which explored the online CSR disclosure in GCC countries, found that only 24.5% of

the companies in the GCC disclose their CSR report, and the companies on average disclose information on only 17 items out of 47. Therefore, non-IT personnel believe that governments should force organisations to apply their CSR concepts.

5.10 Chapter summary

In conclusion, this chapter constructs the final Green IT and sustainability model for the GCC by conducting and analysing survey data. The survey was distributed among three sample sectors: managers, IT personnel and non-IT personnel. Each sector was allocated a different theme and responded to factors contributing to the final model. The manager section of the questionnaire has three themes: governance, social and cultural factors, and green management. Under these themes, eight factors show that managers respond to the survey. The factors generated for these themes are: sustainable resources, Green IT procedures, embedding sustainability, sustainability awareness, government responsibility, recycle management, sustainability policies and Green IT usage. Overall, managers support the change to sustainability but only if it does not negatively affect the current business process.

IT personnel also responded to three themes: Information Technology, Social and Cultural, and Green Management. Each theme also has multiple factors: sustainable data centre, employees' skills development, automated sustainability, cloud computing, embedding sustainability, sustainability awareness, government responsibility, sustainability implementation, recycle management and Green IT usage. The IT personnel section contained the greatest number of survey items as the research was strongly focused on the Information Technology theme. IT personnel believe that technologies and innovation are the key to changing to Green IT and sustainability.

Lastly, non-IT personnel constituted the majority of participants for the survey; they responded to two themes: Social and Cultural, and Green Management. The data from non-IT personnel generated six factors: embedding sustainability, sustainability awareness, government responsibility, sustainability implementation, recycle management and sustainability management. Non-IT personnel believe that sustainability awareness is the first step to change society's perceptions via social media. The next chapter concludes the thesis with a discussion, recommendations and suggested avenues for future research.

CHAPTER 6. DISCUSSION, RECOMMENDATIONS AND CONCLUSION

6.1 Introduction

The last chapter offered the final stage of the study as well as the consolidating factors within the framework that were validated by those who participated in the survey. The data obtained from the survey phase had to be encoded with SPSS, leading to the final model for the Green IT and Sustainability for all GCC countries.

This chapter outlines both research phases that led to producing the framework factors needed for the implementation of Green IT and Sustainability within GCC countries. As discussed in the third chapter, the significant factors needed for the right implementation were identified and derived from a comprehensive review of the literature concerning the role Green IT plays as one pedagogical tool within any IT department.

All the factors were combined to construct an initial framework that comprised factors that were evaluated through a combination of research methodologies, utilising quantitative and qualitative data. All the findings from the data analysis confirmed the significance of specific factors, thereby yielding more sub-factors that were later incorporated in the framework.

This chapter is going to present the last group of factors that are regarded as critical for implementing the proposed Green IT and sustainability model in GCC countries. After all, many recommendations are being offered regarding how to successfully introduce sustainability within GCC countries by overcoming obstacles and preventing possible failures. The aim of these recommendations is to address the needs of those who are using the framework, including all the GCC stakeholders. This chapter gives a brief overview of the research, acknowledges the study's limitations and suggests areas within this field that can be researched in the future.

6.2 Final Framework Discussion and Recommendations

The findings of this research improve the overall perception of Green IT and sustainable development in GCC. The final Green IT and sustainability model (GITSM) was generated from a literature review, interviews and surveys. The model shows that the GCC's major business sector organisations have a Green IT and sustainability strategy. The final GITSM resulting from this research is expected to play a crucial role in helping large organisations from GCC's key economic sectors to handle their Green IT and sustainability implementation more effectively. Figure 64. The final model for Green IT and sustainability in GCC is shown in Figure 88. Each factor will be briefly discussed in the section below.

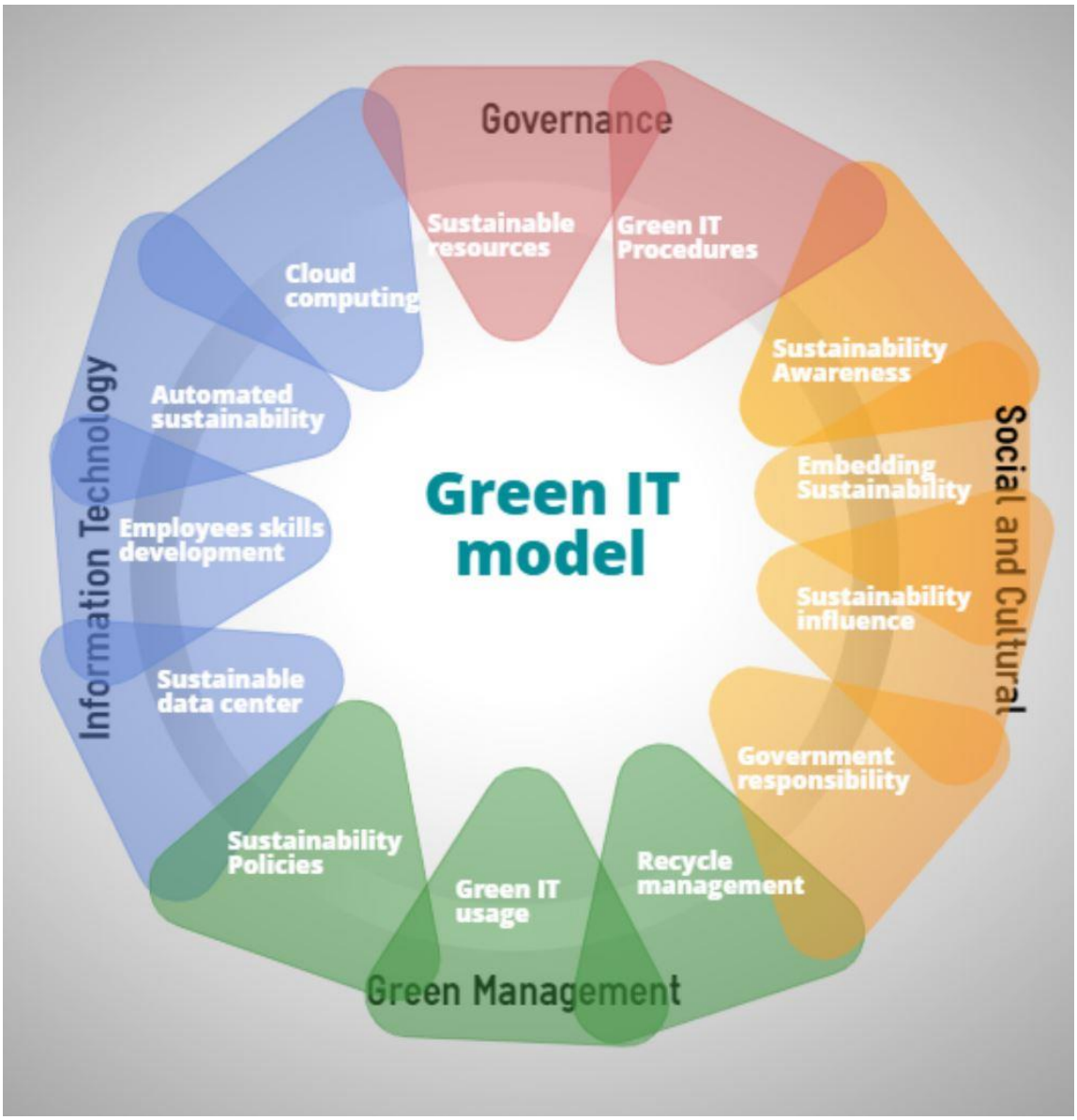

Figure 64. The final model for Green IT and sustainability in GCC

6.2.1 Governance

The commitment of leading managers to several green information technology ideas in high-profile GCC organisations from leading economic sectors has been translated into useful policies for Green IT buying, the environmental use of IT and overall environmental sustainability. Dubey and Hefley (2011) propose an improved greening strategy, which underlies the Green IT vision, initiatives and objectives of all organisations, to improve all Green IT regulations. Molla et al. (2011) state that Green IT-related policies regulating the procurement of Green IT, as well as ecologically responsible ITs, have become popular.
However, the lack of sustainable IT regulations was quite clear, especially when concerns about the environmental disposal of IT were noticed by the Green IT character of the survey, while ecologically friendly IT purchases were remarkably common in GCC organisations surveyed. Nevertheless, since many businesses that have been studied similarly have environmental sustainability strategies, Green IT policies must be included in the company's strategy to become environmentally feasible. This refers to Bohas and Poussing's (2016) review of Luxembourg-based organisations, including corporate social responsibility legislation, including organisational environmental responsibility, and promoting Green IT implementation.

6.2.1.1 Sustainable resources

Several organisations that were investigated have implemented a Green IT framework. For example, some organisations have sustainability and energy officers responsible for Green IT resources. This is in tune with the recommendation of Murugesan and Gangadharan (2012) that the management structure for Green IT and IT buy-ins should be established in conjunction with the implementation of Green IT to ensure that sustainable management agents are engaging in the execution, oversight and control of Green IT.

Therefore, the concern for sustainable resources should guide managers as well as policymakers to use green IT concepts in the workplace such as using email and purchasing sustainable equipment. Also, this factor is helping managers to encourage employees to be more aware of sustainability through training sessions.

6.2.1.2 Green IT Procedures

Based on (Melville, 2010), the structures of companies linked to support environmentally friendly sustainability promote an environmentally optimistic attitude. The same suggestion is made by Molla, Abareshi and Cooper (2014) that Green IT frameworks strengthen Green IT confidence and principles for IT experts. The presence in GCC of several Green IT

management elements also reflects an organisational commitment to Green IT and environmental protection. Green IT procedures aim to develop the concepts of Green IT that help an organization to reduce the cost and time associated with its operations. Also Green IT concepts can guide governments with regard to regulations and policy-making to reduce the $C0_2$ emission as most GCC countries are fully applying regulations that reduce the global emissions.

6.2.2 Social and Cultural

Social and cultural requirements relate to items, buildings and knowledge, such as historical sites and habitats of human beings, as well as principles such as the meaning of the location, local culture and traditions (Claval, 2004). Data are required on both material and immaterial landscape values to give transparent information for policy-makers and stakeholders on the state and trends of social and cultural sustainability (Termorshuizen and Opdam, 2009; Angelstam *et al.*, 2013). But these dimensions are not easily defined or measured; nor are they well developed when included in planning. The strategy and exercise of various scenery situations need therefore be interpreted, appropriate indices and key surveillance techniques are chosen (Antonson, Gustafsson and Angelstam, 2010; Cortese and Hattan, 2010). Therefore, this theme aimed to discuss the social and cultural aspects of GCC countries to investigate how a green IT model will be useful for these nations.

6.2.2.1 Embedding sustainability

Processes and mechanisms for disseminating green IT expertise within organisations were similarly observed for adoption. This sort of system shows the concerns of most key GCC organisations in creating an operating culture for an organisation that values ecologically accountable use of IT. Other researchers endorse this action. For example, Akman and Mishra (2015), in their assessment of Turkish organisations, have found that the Green IT obligations of employees depend on their knowledge of sustainable IT and its benefits. Molla, Abareshi and Cooper (2014) were also supportive of this perspective, which, depending on a study, determined that Green IT consciousness results are required for better Green IT behaviour, with the correct approach and values. Therefore, this encourages the inclusion of sustainability in school curricula as most of participants are agreed to green IT will help change culture attitude. In addition, this factor will help organisations to accomplish their task using Green IT tools.

6.2.2.2 Sustainability awareness

Environmental awareness can give people the knowledge, abilities and attitudes they need to reduce their impact on the environment. Environmental activists have used Green IT to carry out environmental awareness campaigns. The awareness strategy on the knowledge of organizational change has many implications. First, researchers can decide whether GCC organisations have the intention to investigate how organisations in certain situations can and should respond. It can happen that organisations have almost no option as they confront the need to alter, although there are likely to be few organisations in that group. More probably, organisations will collapse under various stages of selection and need to create the finest decisions they can. This decision might be to include an awareness program for the organisation and providing green IT knowledge for the managers to support Green purchases. Overall, the research shows that GCC countries need to be more aware of sustainability through their organisations.

6.2.2.3 Government responsibility

Natural resource degradation is the outcome of three interaction areas: the government, commercial sector, and individuals and their organisations, which are strongly interconnected and influence one another. While regulatory authority is at the centre of press publicity, it is also the business sector that could perform the most significant role in moving towards higher development (Michaelis, 2003; Morioka, Evans and Carvalho, 2016). The GCC countries should encourage organisations to take responsibility for social issues and increase public consciousness of CSR through education in schools. Social media can be a key driver of attitude change and could be used by GCC governments to alter people's behaviours and opinions in regard to sustainable development.

6.2.2.4 Sustainability implementation

Implementing sustainability in the GCC is difficult because the development of sustainability is essentially very different from developing other policies for an organisation. For working objectives, the connection to profit is generally evident. The optimal green objective of development, even though it is long-term and often hard to forecast, assess and handle, is fresh products and procedures, and the main objective is an increase in profit. However, the objective of sustainability is to achieve excellence simultaneously in social, environmental and financial performance. Therefore, this factor finds that GCC people are still using newspapers and television to deliver a serious awareness about sustainability practices such as separating rubbish according to waste and recyclable items, as these have yet to be fully implemented.

6.2.3 Information Technology

In an attempt to support Green IT procedures, the organisations examined have taken advantage of Green technology such as (1) energy-efficient equipment, (2) virtualisation, (3) power effectiveness promotion tools and (4) energy-efficient graphics. The implementation of Green IT technology processes is strongly supported in the literature. For example, Hedman and Henningsson (2011) found that in Danish companies, virtualisation is a successful and popular practice. Jain, Benbunan-Fich and Mohan (2011) have referred to virtualisation, based on their study, as a very prevalent Green IT technology. Green IT technology like computer virtualisation and energy-efficient equipment are being adopted by organisations in Taiwan to encourage greater company responsibility for the environment (Chuang and Huang, 2015)

Molla, Cooper and Pittayachawan (2011) recognised energy-efficient lighting, based on an assessment carried out by their Australian companies, as a type of green IT technology. Ardito and Morisio (2014) are aiming for energy-efficient buildings with eco-innovations such as Building Management Systems. Software for resource efficiency promotion, like collaborative software, are usually used in Chinese organisations (Shi, Bi and Wang, 2010), also seen as efficient IT enforcement interventions for environmental sustainability. Therefore, Information technology aims to help organizations to implement green IT by following the practices described below.

6.2.3.1 Sustainable data centre

Demand for information centre computation has recently increased, and the overall power consumption by information centres globally has increased. Typically, data centres contain three subsystems: IT hardware offers customer services; energy infrastructure produces IT and heating facilities, and the cooling infrastructure reduces heat produced by these subsystems. This factor represents a GCC organisation approach to modelling the energy flows of a data centre and optimising its operation using Green IT concepts. These include regular equipment upgrades as one way to make IT more ecologically safe, as well as adding environmental considerations to IT infrastructure architecture (including data centres).

6.2.3.2 Employees skills development

As other aspects of commercial achievement have become less significant, what remains essential is the organisation, its staff, and how they operate. Employment safety and the dependence on employees to achieve sustainable goals requires that appropriate individuals

are selected in the correct ways. Many GCC organisations offer skills development training (hands-on, online), training courses as well as local libraries. Therefore, this factor aims to investigate the best practices that can help develop green skills for employees in GCC countries. The research found that each organisation has its own program and what it offers depends on the budget offered by the organisation. However, most of the employees prefer hands-on training and courses.

6.2.3.3 Automated sustainability

Environmentally friendly IT providers, as well as several other Green IT requirements for IT purchases (such as green tags and energy-efficiency labels), demonstrates that GCC organisations have been exploring the practices of ecologically responsible IT vendors. These methods are consistent with long-lasting, viable IT buying values suggested in the literature (Erek *et al.*, 2009) to encourage consumers to consider Green IT in their purchasing strategies. Therefore, automated sustainability tools that help data centres to be operated efficiently could be implemented by third-party companies or developed locally. These tools may be in the form of computer metrics or sustainability tools training from the support team to the end-user. The research found that this tool is useful for organisations in GCC countries.

6.2.3.4 Cloud computing

Cloud computing provides online connectivity to people globally. This system results in higher installation and operating costs of cloud information centres as well as significant environmental pollution footprints. Green cloud computing alternatives need to be developed that decrease these operating and implementation expenses, thus saving energy and reducing negative economic effects. A thorough knowledge of energy usage habits in complicated cloud settings is required in an attempt to attain this goal. This factor presents a fresh model for energy use and related cloud-based analytical instrument for organisations in GCC countries. In cloud settings, the amount of energy consumption depends on nature of various operational tasks. Empirical analyses will be explored based on a power usage model and evaluation instrument for the comparison of power usage and cloud information with computing activities and scheme efficiency. In cloud technologies, the research findings in regard to monitoring energy consumption can be used to help linear or vibrant system-level optimisation.

6.2.4 Green Management

In the absence of clear Green IT regulations, it appears that organisations in the GCC are acknowledging that developing Green IT management is quite difficult. This opinion in regard to Green IT, obtained from company personnel, implies that commitment at all levels of the organisational structure is needed if the cultural orientation of the company includes Green IT; only then will the implementation of Green IT be successful (Henney and Donald, 2006; Mishra, Akman and Mishra, 2014). Further, Chuang and Huang (2015) found in their research of Taiwanese companies that a key variable in company sustainability was management prioritising Green IT. Therefore, green-oriented management should aim to maintain the developed green model to ensure its sustainability in the long run. The research has deduced three factors for this theme: management of recycling, Green IT usage, and sustainability policies. Each factor is discussed below.

6.2.4.1 Recycle management

Although GCC organisation was lacking in a comprehensive e-waste management strategy, several processes for Green IT disposal had been employed subsequently. These include the tasks of businesses which are responsible for Green waste, sustainable e-waste governance, reusability of machinery and IT equipment, recycling of computers and printers. This implementation of a Green IT disposal method is encouraged by previous researchers as it is a means of containing the rate at which the generation of electronic waste is increasing. This eco-efficient finding matches the study done by Molla and Abareshi (2012), including e-waste management techniques in Australian businesses as that apply Green IT. Thus, the concerns about IT waste disposal that are ecologically accountable in GCC organisations go beyond Green IT electronically-associated waste strategies that are immediately transformed into Green IT best practices.

6.2.4.2 Green IT usage

The initial Green IT model was designed as a result of studies that revealed that IT energy consumption was an organisational problem. The importance of energy efficiency is in line with the findings of Sayeed and Gill (2010) who mentioned that embracing Green IT concepts is motivated by energy-saving reasons as well as cost benefits. This is supported by Cai, Chen and Bose (2013) who post-surveying over 3000 top managers around the world, argue that reductions in cost due to energy efficiency is one of the top models of business sustainability. This is endorsed by Cai, Chen and Bose (2013), who claim after surveying over 3000 senior staff around the globe, that energy efficiency leading to cost savings is one of the most important reasons for company sustainability. Green IT usage involves tracking the usage of

Green IT practice in organisations to ensure a sustainable process. These practices would be any that apply a green process for either IT or Non-IT. The research found that in order to efficiently maintain the green process in GCC organisations, it is necessary to have a clear plan that is supported by top management.

6.2.4.3 Sustainability Policies

With a strategic approach to IT management, large GCC organisations in the major sectors are establishing their corporate value objective. Similar strategic IT visions were revealed in other research as one move in the field of appropriate IT policies. For example, Bernroider (2008) analyzes over 200 Australian organisations and concludes that many IT initiatives are expected to succeed whenever IT management is implemented by means of strategic IT. Similarly, the Australia-related research of Willson and Pollard (2009) focuses on the importance of global IT policy for effective IT governance. In the current GCC organisations, IT and business strategy were further strengthened through the establishment of IT procedures and strategies that substantially record the use of company IT, IT security and associated duties of the IT department. IT policies and strategies clarify the organizational use of IT and the anticipated results for stronger IT governance. Therefore, sustainability policies aim to ensure that sustainable, efficient policies have been applied for organisations in the GCC, although these policies can differ from one organisation to another.

6.3 The conclusion from the analysis

Answering the core question for this research was: "How can a Green IT Model meet the requirements of GCC countries?"

To summarise findings and answer this question, an extensive literature review was undertaken, and core global themes extracted. These findings were employed in constructing the first framework comprising the factors which may drive the successful implementation of a Green IT and sustainability model for all GCC countries. The first framework as shown in Figure 39 was later subjected to examination during an interview of personnel who highly placed in GCC organisations (e.g. managers). NVivo was applied to analyse the data, and sort and group the factors according to their relevance. The output is shown in the figure below that comprises the crucial key factors that may ensure a successful result of Green IT and sustainability implementation on a large scale by companies within the GCC organisations. The said factors were also shown in Table 55.

The framework indicates the value to those who make decisions by highlighting the advantages along with the risks of implementing Green IT and sustainability as a technical

tool. This proposed framework facilitates the instructional decision-making process regarding integrating Green IT with the IT department and aligning with the needs of the organisation. The structure basically benefits the industry, managers and employees of the organisation who could use these instruments to carry out their technical tasks.

For instance, the framework offers clarity as well as practical guidance for all instructors and policymakers seeking to employ sustainability and Green IT. When deciding the amalgamating Green IT tools, this framework could be implemented as a blueprint for investigating the expected key factors as well as determine whether are appropriate for integrating Green IT tools within the organisations. Or policymakers could use the proposed framework as a diagnostic measure for evaluating their technology infrastructure to determine whether it is suitable for the effective integration of Green IT and sustainability tools.

Also, for instance, an investigation of the technology factors as well as sub-factors in the proposed framework would expose problematic matters like poor awareness programs, that obstruct the process of integrating Green IT tools into a sustainability strategy. Analysing these factors within the technology context where it will be used is of utmost importance in mitigating the possibility of failure and improving the general instructional result. Figure 65 illustrates the possible users as well as beneficiaries of the proposed framework.

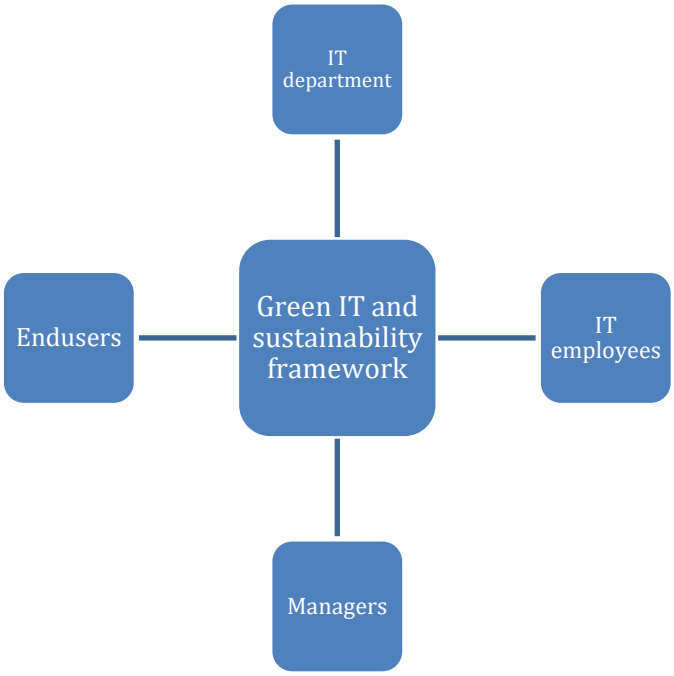

Figure 65. End-users who benefit from Green IT and sustainability

First Research Sub-Question: What are the perspectives of various stakeholders in GCC countries concerning the Green IT model?

This question is related to discovering the stakeholder's perspectives in terms of social, economic and technological variables that should be considered when designing Green IT and sustainability frameworks in GCC countries. It was found that the GCC nations have a great many similarities with other countries worldwide, particularly since cultural distinctions are now sometimes blurred as a result of this region's acceptance of modern ideas and behaviours which are constantly evolving, the study disclosed, however, that the GCC is ambivalent in terms of sustainability. However, stakeholders, particularly workers and managers, are pleased and willing to apply creative technology, with States and companies willing to spend enormous amounts to develop ICT within their organisations.

GCC still maintains its social and cultural characteristics, its regular staff and a Green IT template that is not acceptable in terms of sustainable ideas. Similarly, while ICT budget spending is highly substantial, evidence shows that equipment, customer help, instruction and elevated consciousness are not the norm, with customer understanding as well as skill remaining relatively small (Aldosemani, Shepherd and Bolliger, 2019). Therefore, other factors apart from technology should be considered when using Green IT in GCC IT services; any successful applicant will require a thorough assessment of GCC customers ' requirements in an evolving and traditional socio-cultural context. Consequently, confidentiality issues, as well as the governance of privacy issues, are of great importance to the management of accessible data.

In order to obtain views and opinions about the preliminary model and the Green IT usage, the structure mentioned in Figure 65 was first developed after the literature review. From the interview stage, a new subfactor emerged; there was also an amendment to the green management theme by changing the E-waste to recycle, as recycling is a more general concept and will cover different elements. During the survey stage, many variables have been removed to minimise the number of factors; therefore, in this stage, almost all the factors have been grouped under the new detected factors.

The survey phase eliminated thirteen factors under four themes. The sub-factors did not load cleanly to a single factor. Nevertheless, the researcher decided to retain some factors to be examined during the survey stage. Finally, the survey stage confirmed the general findings of every phase and suggested that participants perceived that the framework was effective. Additionally, the participants verified the significance of the factors that were retained.

Second Sub Research Question: How can a Green IT model will be useful for IT departments in GCC countries?

The research indicates that the use of Green IT and sustainability facilities was accepted by IT employees and managers who did not believe that cultural aspects of the GCC were a serious impediment to the success of Green IT. However, the current culture and behaviour of GCC people shows that there is the need for a stronger awareness of Green IT concepts. Although some barriers were mentioned, IT employees were positive about applying the recent Green IT technology in their IT departments because of the variety of useful tools that green can provide. This aligns with the reshaping of the GCC to achieve the goals of its vision.

6.4 Research Limitations

Every research project has limitations, which can point to avenues of future research. With this research, many limitations were discovered and are connected to the cultural side of the GCC countries.

Firstly, despite recent improvements, because of gender bias in terms of positions within companies, there was a very small number of females available for interview, and it was very challenging to encourage them to participate and arrange their involvement. This shows that most females in the GCC are not used to participating and publicly communicating their emotions. However, this was not the case for every female respondent, one of whom is an educator who had studied overseas gave long, wide-ranging feedback. Thus, females were not well-represented in this study.

Another limitation had to do with the budget available for the research. The GCC comprises countries that are geographically huge as well as dispersed. Therefore, the researcher could not afford the cost of accommodation and flights for the two data collection stages. This situation was made worse by the researcher residing in Australia. Nevertheless, the researcher undertook two trips to the GCC countries for data collection.

Additionally, the time difference between Australia and the GCC was also a hindrance, because contacting participants was more challenging. This is because GCC companies' working hours do not coincide with those of companies in western nations with lengthy holiday periods in the picture. These factors affected the ease with which communication was done with GCC companies and with participants to arrange for the collection of data.

Nevertheless, the researcher was able to get in touch with potential participants and carry out interviews with the obtained sample size. Additionally, the required data was obtained from companies within the metropolitan region, which meant that the regional and rural population samples were not included in the research. Another obstacle was the bureaucracy of companies within GCC that are hierarchically arranged, which made it difficult to receive permission to conduct the research. Additionally, not every organisation's departments were positive about the research, consequently rejecting requests.

Finally, from a practical point of view, numerous incomplete responses were returned. This indicated participants' lack of motivation to complete a voluntary survey, or they might have been familiar with the concepts on which the research was based.

In conclusion, there were other potential limitations that the researcher avoided. For instance, a quiet place was arranged for interviews with managers who participated. Generally, it was not possible to avoid every limitation. However, it is assumed that the research offers a good view concerning the factors which are needed to introduce Green IT and sustainability to companies within the GCC, and these findings can be used by IT departments seeking entry to implementation.

6.5 Significance & Further Research

The main objective of this research was to establish a framework that can be used by different stakeholders as a guide to the implementation of Green IT in the business sectors of the GCC. This study in the initial effort of pinpointing factors which must be considered for Green IT and sustainability adoption in this particular socio-cultural region.

The research findings show that the GCC is in a position to reap the benefits of Green IT, and the end-users in the sample supported the crucial factors that comprise the framework for Green IT and sustainability implementation within IT departments. There are many implications for more research that could advance the views provided by this investigation.

First, this study formulated and analysed an implementation framework. A necessary extension will be to ideally implement Green IT in GCC organisations in line with the framework factors to determine whether the framework is adequate or whether more factors should be addressed. The effectiveness of this framework as an implementation blueprint could be tried and tested.

Another future study undertaking could involve replicating this study using various methods

and tools like NVivo as well as SPSS, as this could yield different results that can be considered when Green IT implementation is being considered by IT departments.

The limitation encountered by this research regarding sample size has been noted. Another consideration for further research could be to conduct the study with more respondents, increasing the validity and generalisability of findings. Future studies could offer incentives to encourage more participation.

Another way to advance research in this area is to investigate attitudes as well as perceptions of Green IT among the rural and regional areas of the GCC countries. This research examined Green IT and sustainability in the urban areas of GCC countries. Arguably, sustainability tools can offer huge advantages to IT personnel in data centres, creating a knowledge repository, with sufficient technology infrastructures being assured. Therefore, a study of the way Green IT could be implemented within the GCC countries that are more marginalised could yield different success factors altogether.

Considering the existing adoption of GCC vision, and a core set of reforms focused on modernising the GCC as well as making it one of the leading nations worldwide, it will be useful to conduct a precise longitudinal study that examines the dynamic understanding of stakeholders regarding sustainability, and takes into account the various socio-cultural factors in the GCC environment. The socio-cultural analysis of the GCC, conducted in this research, may provide different results as new values and ideologies emerge in the Kingdom. This can include fewer restrictions for women in terms of societal participation since human rights for women have improved. Therefore, there is huge potential for research to be conducted on these areas in future in relation to the GCC, because very little has been published so far concerning Green IT as well as sustainability in companies within these countries.

6.6 Chapter summary

This chapter presented the general findings of this research by listing the crucial factors that were discovered for using the framework to implement Green IT and sustainability within organisations in GCC. These factors have been confirmed by all the respondents during the phase of data collection, and must be taken into consideration to ensure successful outcomes for the integration of Green IT within companies. For every factor, this chapter offers recommendations regarding the incorporation of Green IT optimally within GCC, given its special cultural, social and technological context. The limitations of the study were acknowledged, and recommendations were made for future research directions. In conclusion, this research has found that the GCC is well-positioned to use Green IT and sustainability fulfil its current vision, and it could benefit from such tools.

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APPENDIX I

Governance | Social & cultural | Information Technology | Green Management

O: Objective Q: Question

Num	Interview Questions	Matching with the Research Question and Objectives	Green IT Characteristics	Category	Resource
1	Sustainability is a term that widely used in different nations to maintain their practicals and save the environment. Do you have a sustainable plan in your personal life such as waste recycling or using recycled materials, using renewable energy and purchasing only environmental friendly produces? If yes, why, and no why?	*General question to open the conversation and assess the interviewer's understanding of sustainability*	*General*	-	-
2	Appling Green IT means that the organisations will reduce the usage of a natural resource such as power (Oil and Gas) and water. Do you think that adoptions of Green IT will lead your government to find profits from other resources? If yes why, and no why?	*These questions gives the perspectives from stockholder the effectiveness of Green IT adoptions in term of politically O:1 Q:1*	*Political*	*Governance*	(Hashmi and Al-Habib, 2013) *p.145*
2.1	Share with us what are the political issues that might occur if your organisations adopt Green IT?				
3	Organizations in developed countries are forced by law to reduce CO2 emissions footprint, which led organisations to use a limited number of products that harm the environment. How would you overcome such a case in your organisations if a law applied from your government? Take on account the prices of environmental products usually are costly.	*This question gives the perspectives from stockholder the effectiveness of Green IT adoptions in term of legal O:1 Q:1*	*Legal*	*Governance*	(Epstein and Roy, 2007) *p.398*
4	Sustainability usually improves social and economic for current and future generations, also increase the quality of life and to makes people live in a healthy environment. What skills and knowledge are most critical in social changes regarding Green IT adoption in your organisation?	*These questions give the perspective of stakeholder is concerning the Green IT model for social aspects O:2,3 Q2,3*	Social & cultural	*Social*	(Al-Gahtani *et al.*, 2016) *p.41*
4.1	Do you think that adopting Green IT model will increase the organisation's awareness of policies importance toward sustainable business practices?				(Molla, Cooper and Pittayachawan, 2009)
5	Values and beliefs of the organization's culture can impact the behaviour of individuals. How an effective Green IT model adoption can impact individuals' attitudes?	*The question gives how Green IT model useful for individuals. O:1 Q:1*	Social & cultural	Cultural	(Esfahani *et al.*, 2015) *p.37*

6	The drivers of Green IT: economic, regulatory and ethical; also Self-Motivation represented as the ethical driver during the Green IT implementation. How your organisation will assist individuals to ethically motivate such as providing Green IT awareness during Green IT implementations?	*To assess the GCC's needs in term of ethical* *O:2,3* *Q:2,3*	Social & cultural	Ethical	(Thomson *et al.*, 2015) *p.174 & 175*
7	Do you think that Green IT model adoption will give the company more social acceptance in your country if yes why, no why!?	*Give an idea about acceptance of Green IT model from the social* *O:2,1* *Q:2,1*	Social & cultural	acceptance	(Baker, Al-Gahtani and Hubona, 2010) *p.36 & 39*
7.1	What are the cultural and social characteristics that influence individuals' technology acceptance?				
8	The organization that wants to represent as socially responsible needs to take account of four components economic, legal, ethical, and philanthropic responsibilities. Does your organisation adopt any of these components responsibilities in any strategy, if yes why and no why	*This question gives an idea about does this organisation have adopted and CSR matters.* *O:1* *Q:1*	Social & cultural	CSR	(Esfahani *et al.*, 2015) *p.37*
9	What type of smart technology such as smartphone, tablet and wearable devices are used in your business?	*These questions assess the needs for GCC in term of smart technology* *O:1,3* *Q:1,3*	Information Technology	Smart Technology	(Ramli and Twaha, 2015) *p.654*
9.1	Does the organization have a recycling plan for these devices after being used? If yes why and no why				
10	An important aspect of the use of the IT technical infrastructure is to solve sustainability issues to make sure that the applications themselves in their architecture are Green. Does your organisation use green architecture in their applications, either software or hardware? If yes why and no why!	*This question assesses the organisation's architecture green level, as part of assess GCC needs* *O:1,3* *Q:1,3*	Information Technology	Architecture	(Molla, Cooper and Pittayachawan, 2009) *p.2*
11	Recently IT department operation is costly due to the high demand on storage and network equipment; however, there are alternative ways to reduce this cost i.e. cloud and virtualisation. How would you overcome the datacentre demand in your organisation?	*These questions to assess the GCC organisations datacentre and find the hardware needs* *O:2,3* *Q:2,3*	Information Technology	Hardware	(Uddin and Rahman, 2012) *p.4079*
11.1	Does your business use cloud data cetner solutions, such as Amazon AWS and Microsoft Azure? If yes why and no why?				
12	Virtualisation is attached to entire computer architecture in software which provides the virtuality of a real machine including all software running on it. Do you have a virtualisation machine	*These questions assess GCC needs in term of software for*	Information Technology	Software	(Kiyanclar , 2005)

	installed in your organisations? If yes why and no why	*both user and developers* *O:3* *Q:3*			
12.1	As a virtualisation machine user, what are difficulties that faced during normal work?				
12.2	As a virtualisation machine developer What expected technical issues and management difficulties while installing process? How will you manage to overcome these issues?				
13	"Green metrics is a software tool for collecting or simulating, analysing, modelling, reporting energy consumptions, environmental risk management, environmental impact, and greenhouse gas emissions". Do you think these metrics tools will be useful for your organisations?	*This questions assess the IT department needs in term of IT practicals/metrics* *O:2,3* *Q:2,3*	Information Technology	practicals/metrics	(Ardito and Morisio, 2014)
13.1	Does your organisation apply any of these tools? How these tools reflected in your work? Tools such as power monitoring, calculate CO2 usage and power management, calculator.				
14	In terms of environmental performance information technology, technical infrastructure could increase the efficiency of environmental management processes by analysing, monitoring and streamlining business processes. Do you think to mentor the environmental performance will be reflecting well to the organisation business? How?	*This question assesses the IT department needs in term of IT practicals/monitors* *O:1* *Q:1*	Information Technology	practicals/monitors	(Wang, Chen and Benitez-Amado, 2015)
15	The best way to change current attitudes for organisations' staff is providing them education and training. What is the followed system in your organisations in order to change individuals' attitudes?	*This questions matched with does the Green IT model is useful for GCC IT department* *O:1,3* *Q:1,3*	Information Technology	Training	(Unhelkar, 2012)
15.1	Do you think users are changed their attitudes after the training finished? Could please rank this change from 0 to 10?				
16	Providing analytical tools and IT support for businesses that targeted to reduce CO2 emission will ensure both direct and indirect success of the implementation. Do you think support is one of the critical aspects to maintain the new system? How? If yes why and if no why?	*This question matches with doing the stakeholders' concerning Green IT model.* *O:1,2,3* *Q:1,2,3*	Information Technology	Support	(Molla, 2008)
17	Recent research shows these hypothesised; Firstly E-wastage disposal has a positive effect on global warming. Secondly performance of eco-friendly IT products has a positive connection to e-wastage disposals. Do you think that applying e-waste to	*To assess the GCC needs in term of e-waste* *O:1,2* *Q:1,2*	Green Management	e-waste	(Khan, Khan and Ravinath, 2014)

	organisations will increase IT performance? If yes why, and if no why				
17.1	Please provide some example of successful e-waste implementation in your organisation?				
18	Green IT endeavours to accomplish economic suitability and enhanced system performance and use. Do you think a new economic Green model will affect on your current business process? Positive or negative? If yes why and no why!	*This question assesses stakeholders in GCC concerning Green IT model in term of Economical* *O:1,2* *Q:1,2*	Green Management	Economical	(Murugesan and Gangadharan, 2012)
19	"Pro-environmental IT practices is private-sphere environmentalism in the purchase, use, and disposal of IT". Does any of these terms are used in your organisation? If yes why and no why?	*This question assesses stakeholders in GCC concerning Green IT model in term of Environmental* *O:1* *Q:1*	Green Management	Environmental	(Molla, Abareshi and Cooper, 2014)

APPENDIX 2

Curtin University

Green IT model for GCC

PARTICIPANT INFORMATION STATEMENT

HREC Project Number:	*10752*
Project Title:	*GREEN IT MODEL FOR IT DEPARTMENTS IN GULF COOPERATION COUNCIL (GCC) ORGANISATIONS*
Principal Investigator:	*Dr Tomayess Issa – Supervisor* *Dr Theodora Issa – Co-Supervisor* *Associate Professor Vanessa Chang – Co-Supervisor*
Student researcher:	*Abdulaziz Albahlal*
Version Number:	*1*
Version Date:	*08/07/2016*

What is the Project About?

Green Information Technology (Green IT) is an essential term for modern-day organizations that wish to reduce their environmental impacts. GCC is a group of countries comprising six Arabic countries: Saudi Arabia, the United Arab Emirates (UAE), Qatar, Oman, Bahrain, and Kuwait. GCC countries have the highest energy consumption in the world. There are several Green IT models that aim to solve a very specifics issues or some of other Green IT model introduced to targeted counties.

This research will provide a thorough investigation of different Green IT model and will conclude with a Green IT model that suits GCC. It will conduct both qualitative and quantitative research with multiple levels of employees to obtain data pertaining to their opinions, routines, areas of improvement, and willingness to learn the new system.

This research aims to develop a Green IT model for GCC in IT departments to reduce the environmental impacts. Many different available strategies have been proven to reduce power consumption, paper use, and smart technologies are used to reduce process time. Potential gaps have been identified and detailed with solutions to maximum efficiency and effectiveness.

Organisations in GCC countries do not consider sustainability to reduce their environmental impacts. GCC countries are causing a great deal of environmental damage due to their economic growth in different sectors such as oil, gas, and telecommunications. Furthermore, GCC countries are sharing the same policies to achieve the financial stability and change in the oil market.

Children and adolescents are not part of this project. Only maximum 20 adult will participated in the interviews

Who is doing the Research?

- *The project is being conducted by Abdulaziz Albahlal.*
- *The results of this research project will be used by Abdulaziz Albahlal to obtain a Doctor of Philosophy at Curtin University and is funded by the University.*
- *There will be no costs to you and you will not be paid for participating in this project.*

Why am I being asked to take part and what will I have to do?

- *You have been asked to take part because you have ability to answer questions regarding to Information Technology and Sustainability*
- *Participation will involve in a personal interview.*
- *The study will take place at a mutually convenient location in either physical or virtual locations.*
- *Each interview will takes between 30 to 60 minutes.*
- *There will be no cost to you for taking part in this research and you will not be paid for taking part.*
- *We will make a digital audio recording so we can concentrate on what you have to say and not distract ourselves with taking notes. After the interview/focus group we will make a full written copy of the recording.*

Are there any benefits' to being in the research project?

- *There may be no direct benefit to you from participating in this research.*

- *People appreciate the opportunity to discuss their opinions about Green IT and sustainability in GCC.*

- Project benefits other people in the future,
  - *Develop and Green IT model for GCC*
  - *Reduce the Green Gas Emissions in GCC countries*
  - *Shift IT department in GCC to environmental department using renewable energy.*
  - *Benefits to scholars to investigate the recent challenges to IT greening process development on the basis of up-to-date information*

Are there any risks, side-effects, discomforts or inconveniences from being in the research project?

- Describe all possible known risks, side-effects and/or discomforts. These can be physical and psychological/emotional. Do not sate that there are "no risks". You can state: *There are no foreseeable risks from this research project.*

- If appropriate, include a sentence stating that there may be additional unforeseen or unknown risks. Tell participants how you will let them know about them for example: *During the research project we may find out new information about the risks and benefits of this study. If this happens we will tell you the new information and what it means to you. It may be that this new information means that you can no longer be in the study or you may*

choose to keep going or to leave the study. You might be asked to sign a new consent form to let us know you understand any new information we have told you.

Who will have access to my information?

- *The information collected in this research will be non-identifiable (anonymous). This means that we do not need to collect individual names. No one, not even the research team will be able to identify your information. Any information we collect and use during this research will be treated as confidential. The following people will have access to the information we collect in this research: the research team and the Curtin University Ethics Committee*

  - How information will be stored?
    Electronic data will be password-protected and hard copy data (including video or audio tapes) will be in locked storage.

  - How long the information will be stored and what happens at the end of the storage period?
    The information we collect in this study will be kept under secure conditions at Curtin University for 7 years after the research has ended and then it will be destroyed.

  - *You have the right to access, and request correction of, your information in accordance with relevant privacy laws.*

  - *The results of this research may be presented at conferences or published in professional journals. You will not be identified in any results that are published or presented.*

Will you tell me the results of the research?

- A summary of the project's overall results should be sent to participants.

- *We are not able to send you any results from this research as we do not collect any personal information to be able to contact you.*

- *The results of the research will be published in Curtin library after PhD grade obtained.*

Do I have to take part in the research project?

- *Taking part in a research project is voluntary. It is your choice to take part or not. You do not have to agree if you do not want to. If you decide to take part and then change your mind, that is okay, you can withdraw from the project. You do not have to give us a reason; just tell us that you want to stop. Please let us know you want to stop so we can make sure you are aware of any thing that needs to be done so you can withdraw safely. If you choose not to take part or start and then stop the study, it will not affect your relationship with the University, staff or colleagues.*
  If you chose to leave the study we will use any information collected unless you tell us not to.

What happens next and who can I contact about the research?

- Provide a title, first name and surname for the most appropriate researcher or contact person to obtain further information or answer questions.
- Give the most direct telephone number.
  - Mr Abdulaziz Albahalal – +61451106157
  - Dr Tomayess Issa – +618 9266 7682
  - Curtin University library - +61 8 9266 7166

- How you will obtain their consent:
  If you decide to take part in this research we will ask you to sign the consent form. By signing it is telling us that you understand what you have read and what has been discussed. Signing the consent indicates that you agree to be in the research project and have your health information used as described. Please take your time and ask any questions you have before you decide what to do. You will be given a copy of this information and the consent form to keep.

Curtin University Human Research Ethics Committee (HREC) has approved this study (HREC number HRE2016/0153). Should you wish to discuss the study with someone not directly involved, in particular, any matters concerning the conduct of the study or your rights as a participant, or you wish to make a confidential complaint, you may contact the Ethics Officer on (08) 9266 9223 or the Manager, Research Integrity on (08) 9266 7093 or email hrec@curtin.edu.au.

APPENDIX 3

الهيئة السعودية للمواصفات والمقاييس والجودة
Saudi Standards, Metrology and Quality Org.

To Whom It May Concern

Dear Sir/Madam

This is to inform that we are going to accept and supervise Mr.Abdulaziz Ahmed Albahlal, during his academic journey to the GCC for collecting data. Also we would like to keep informed that Mr. Abdulaziz Ahmed Albahlal has been granted scholarship by Ministry of higher education studying towards a PhD degree in Information Systems at Curtin university, Perth, Western Australia. Also, Albahlal's journey start from (15/09/2016 until 31/10/2016), and his research title is "GREEN IT MODEL FOR IT DEPARTMENTS IN GULF COOPERATION COUNCIL (GCC) ORGANISATIONS".

Wishing him success in his endeavor.

Please feel free to contact us if you have any further queries.

Director General IT Dept

[redacted]

Ahmed M. Almeqhem

a.meqhem@saso.gov.sa

RIYADH الرياض
الهيئة السعودية للمواصفات والمقاييس والجودة
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APPENDIX 4

CONSENT FORM

HREC Project Number:	*10752*
Project Title:	*GREEN IT MODEL FOR IT DEPARTMENTS IN GULF COOPERATION COUNCIL (GCC) ORGANISATIONS*
Principal Investigator:	*Dr Tomayess Issa – Supervisor* *Dr Theodora Issa – Co-Supervisor* *Associate Professor Vanessa Chang – Co-Supervisor*
Student researcher:	*Abdulaziz Albahlal*
Version Number:	*1*
Version Date:	*08/07/2016*

- I have read, *{or had read to me in my first language – delete if not appropriate}*, the information statement version listed above and I understand its contents.
- I believe I understand the purpose, extent and possible risks of my involvement in this project.
- I voluntarily consent to take part in this research project.
- I have had an opportunity to ask questions and I am satisfied with the answers I have received.
- I understand that this project has been approved by Curtin University Human Research Ethics Committee and will be carried out in line with the National Statement on Ethical Conduct in Human Research (2007).
- I understand I will receive a copy of this Information Statement and Consent Form.

Participant Name	
Participant Signature	
Date	

Declaration by researcher: I have supplied an Information Letter and Consent Form to the participant who has signed above, and believe that they understand the purpose, extent and possible risks of their involvement in this project.

Researcher Name	Abdulaziz Albahlal
Researcher Signature	
Date	

FOR USE IN PROJECTS WITH IMPLIED CONSENT

Please insert the following tick box at the top of your questionnaire.

☐	I have received information regarding this research and had an opportunity to ask questions. I believe I understand the purpose, extent and possible risks of my involvement in this project and I voluntarily consent to take part.

☐ I do	☐ I do not	consent to being audio-recorded

☐ I do	☐ I do not	consent to the storage and use of my information in future ethically-approved research projects related to this (project/disease)

APPENDIX 5

Part 1: Background information

1. Please indicate your gender:
    a. Male
    b. Female
2.
3. Please indicate your age
    a. 20 and under
    b. 21-30
    c. 31-40
    d. 41-50
    e. 51-60
    f. Over 60

4. What is your main field(s) of work:
    a. Accounting
    b. Business law
    c. Economics and Finance
    d. Information Systems
    e. Information Technology
    f. Computer Science
    g. Management
    h. Marketing
    i. Health Sciences
    j. Humanities
    k. Science and Engineering
    l. Art and Design
    m. Other- please specify ……

5. What is your job position:
    a. CIO
    b. Manager
    c. Non-IT employee
    d. IT employee

6. How long your experience in your field of work:
    a. Less than 1 year
    b. From 1 year to 5 years

c. More than 5 years

7. Please choose your education level:
    a. Primary Education
    b. Higher Secondary/Pre-University
    c. Professional Certificate
    d. Diploma
    e. Advanced/Higher/Graduate Diploma
    f. Bachelor's Degree
    g. Post Graduate Diploma
    h. Master's Degree
    i. Doctorate Degree

8. What do you use sustainability for in your personal life:
    a. Reduce, Reuse, and Recycle
    b. Make Wise Purchasing Decisions
    c. Grow Your Own Food
    d. Nothing

Please indicate your level of agreement to each statement: **Governance** is the way to study the issues that might occur by government actions.	**Strongly Agree**	**Agree**	**Natural**	**Disagree**	**Strongly Disagree**

Legal					
Green IT project will be profitable to					
To the government					
To my organisation					
My organisations should					
Save the natural resources					
Force us to stop using the papers					
Use sustainable materials					
Political					
When My organisation going to install Green IT model we will					
Have political issues					

Effect their reputation internationally					
Developing Green IT concepts will reduce					
Our business process cost					
Our business process time					
The government showed release a footprint policy to force organisations to reduce the usage of CO2.					

Please indicate your level of agreement to each statement: **Social and Cultural** is the way to study how the new model will be accepted from the people.	**Strongly Agree**	**Agree**	**Natural**	**Disagree**	**Strongly Disagree**

Social					
People in my country are not aware of					
Sustainability					
Environment					
Reduce the papers					
The most used media channel in my country is					
Social media					
Watching TV					
Newspapers					
Cultural					
We have to					
Segregate our bin to rubbish and recycle					
Use only recycled paper in our school books					
Use the technology in our school to reduce the papers					
Give classes about sustainability in our school					
Acceptance					
Green IT will help us to change our					

thoughts about the environment					
The way how to accomplice our tasks					
The idea about accepting new systems					
Social media is					
The best way to change people mindset about sustainability					
Riser the chances to acceptance Green IT model					
Ethics					
My job is					
Help me to change my mentality					
Help me to apply what I learnt in my work to my personal life					
They focus on change behaviour to be a better worker					
Companies that promoted their self as they are environmentally					
They are interesting for me to purchase their products					
I prefer them than others who not care about the environment					
Corporate Social Responsibility (CSR)					
Organisations in my country are					
Responsible about the social					
They built various free project for the social					
They need more awareness about CSR					
My government should					
Force the organisations to be responsible for the social					
Raise the awareness about CSR to the public through the schools					

Please indicate your level of agreement to each statement: **Information Technology** is the main factor for this research.	**Strongly Agree**	**Agree**	**Natural**	**Disagree**	**Strongly Disagree**

Smart Technology					
The technologies that we are using in my organisation are					
Very useful for our business					
Makes our business faster					
No need to improve it					
We are using all type of technologies in our business (computer, phone, tablet)					
I think we need to change our current technologies					
Architecture					
In our data centre					
We have a heat management system					
Consider the environment before the extension process					
Use the right application to reduce the power					
We use Green Cloud in our organisations					
We do only focus on the quality nothing else					
Hardware					
When our data center required more storage, I would prefer to					
Add new storage volume					
Using Cloud solutions					
Remove old data and add the new one					

Change the recovery method					
Storing our data infamous companies such as Amazon and Google					
Our data not on save and might be stolen					
We have to only store only non-sensitive data					
Software					
Using a virtual machine is					
Difficult compared with regular computers					
Save my life many times (data stored in the Datacenter)					
Installing a virtual machine is					
Very difficult					
Hard to hire experts people					
We are using Email as the primary method to finish our work					
Training					
For developing our skills, our organizations					
provides very useful training for self-learning					
They have a library and training sessions rooms					
They provide training on our demand					
We receive various awareness programs from our IT team					
We are aware of how risky using the data					
Support					
Our support team is					
Well trained for most of the technical issues					
They solve the problem as fast as they can					
They do have different people for different issues					
They provide classes for training new systems					
Practice					
Using computer metrics for our datacentre					
is powerful tools					
give us more control to our machines					

We use tools to control the datacenter heat					
We are using power monitoring in our organization					
We never had any problem of using metrics tools					

Please indicate your level of agreement to each statement: **Green Management** will ensure the implementation of Green IT model is maintained for long time	**Strongly Agree**	**Agree**	**Natural**	**Disagree**	**Strongly Disagree**

Recycle					
We have a recycling system in our organisation					
We are reusing our equipment					
My government is					
Supports the recycling program					
Providing channels for accepting the old machines					
Use email to contact them					
Economic					
Using the cloud storage in my organisation					
Is cheaper for a long run					
Easier to maintain it					
Updating our computers					
Is very costly					
Takes a long time to update					
Hard to destroy the old storage					
Environmental					
My organisation					
Is concern about purchasing the environmental products					

The price is not issue if the product has better features					
We have some environmental product in our organisations					
We develop a sustainable application in our systems					
We have to use environmental-friendly produces					

APPENDIX 6

Curtin University

Office of Research and Development

GPO Box U1987
Perth Western Australia 6845

Telephone +61 8 9266 7863
Facsimile +61 8 9266 3793
Web research.curtin.edu.au

18-Oct-2017

Name: Tomayess Issa
Department/School: School of Information Systems
Email: Tomayess.Issa@cbs.curtin.edu.au

Dear Tomayess Issa

RE: Ethics Office approval
Approval number: HRE2017-0740

Thank you for submitting your application to the Human Research Ethics Office for the project **GREEN IT MODEL FOR IT DEPARTMENTS IN GULF COOPERATION COUNCIL (GCC) ORGANISATIONS**.

Your application was reviewed through the Curtin University Negligible risk review process.

The review outcome is: **Approved**.

Your proposal meets the requirements described in the National Health and Medical Research Council's (NHMRC) *National Statement on Ethical Conduct in Human Research (2007).*

Approval is granted for a period of one year from **18-Oct-2017** to **17-Oct-2018**. Continuation of approval will be granted on an annual basis following submission of an annual report.

Personnel authorised to work on this project:

Name	Role
Albahlal, Abdulaziz Ahmed A	Student
Issa, Tomayess	CI
Issa, Theodora	Co-Inv
Chang, Vanessa	Co-Inv

Approved documents:

Document

Standard conditions of approval