



**Green building strategy to mitigate climate change: A case of
Department of Public Works in KwaZulu-Natal.**

by

Morwesi Annah Dladla

Student Number

214580461

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Graduate School of Business and Leadership

Supervisor: Dr. M. Kanyangale

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DECLARATION

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- i) The research reported in this thesis except where otherwise stated is my original research.
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ABSTRACT

Government is one of the biggest tenants when it comes to office space in the province of KwaZulu Natal (KZN) such that the adoption and implementation of green building as a way to mitigate climate change is very important.

The objective of this study was to investigate how professional engineers in the Department of Public Works in KZN consider the green building as a strategy in choosing space for government use. For the purpose of this study qualitative research approach was adopted. Purposive sampling method was used to select 10 professional engineers within professional services division in DPW in KZN. Data were collected using semi-structured and in-depth interviews with the selected professional engineers. Data were analyzed using thematic analysis to induce themes reflecting what professional engineers consider in selecting office space for government use, capabilities of professional engineers in choosing office space and recommendations for the implementation of green building strategy.

The results of the study reveal that professional engineers at the DPW consider enhancing of energy saving and efficiency, saving on consumption of operational costs, internal comfort of the users of the building, enhancing water saving and efficiency, and accessibility of the building to the public when considering green building and choosing space for government use.

Three capabilities which professional engineers actually have to implement green building strategy include the ability to assess the usage of energy efficiently, ability to assess the usage of water efficiently, and ability to analyze features of green indoor environmental quality. However, the study has revealed that the implementation of green building strategy may not succeed as professional engineers in KZNA lack a systemic approach to green building as a response to climate change, ability to monitor and evaluate the green building performance and green leasing skills. In this study, professional engineers recommended that an integrated approach to enhance green building, educational training and awareness to all clients departments, supportive organizational structure for green building activities and the building of green technical capabilities of professional engineers in public sector were important to ensure the implementation of green building as a strategy to mitigate climate in KZN. The findings have implications on strategy implementation and efforts to build the relevant capabilities of professional engineers to excel in green leasing for government. Areas for future research are also highlighted.

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ACRONYMS AND ABBREVIATIONS

BREEAM:	BRE Environmental Assessment Method
CASBEE:	Comprehensive Assessment System for Built Environment Efficiency
CIDB:	Construction Industry Development Board
DPW:	Department of Public Works
GBCA:	Green Building Council of Australia
GBC:	Green Building Council
GBCSA:	Green Building Council of South Africa
GIAMA:	Government Immovable Assets Management Act
GMS:	Green Mark Scheme
GRI:	Global Reporting Initiative's
HKBEAM:	Hong Kong Building Environmental Assessment Method
IPCC:	Intergovernmental Panel on Climate Change
LEED:	Leadership in Energy and Environmental Design
PRS:	Pearl Rating System
UKZN:	University KwaZulu Natal
UNFCCC:	United Nations Framework Convention on Climate Change

CHAPTER 1: INTRODUCTION AND BACKGROUND OF THE STUDY

1.1 INTRODUCTION

"Since the Industrial Revolution, the world has witnessed innumerable technological achievements, population growth, and corresponding increases in resource use. As we enter a new century, we recognize the side effects of our activities in the form of pollution, landfills at capacity, toxic waste, climate change, resource depletion, and deforestation. These efforts are straining the limits of the earth carrying capacity - its ability to provide the resources required to sustain life while retaining the capacity to regenerate and remain viable" (Building, 1998).

Green Building offers government in Africa a fantastic opportunity to save energy, reduce waste, cut down on greenhouse gas emissions, conserve natural resources; all while improving water and air quality. Green Buildings also offer their occupants better health and productivity and are additionally cost-efficient to operate.

The article *"Green Building in South Africa: Emerging Trends"* developed by the Department of Environmental Affairs and Tourism (DEAT) in 2009, it is clear that green building aims to create an environment that is sustainable through targeting for low carbon emissions, energy and water efficiency. In offices, there is a need to address lighting and heating, ventilation and air-conditioning (HVAC) and comfortable indoor temperatures as some of the aspects of green building and office space.

One of the most critical and urgent problems facing the world today is climate change, which requires the government to play a vital role in various ways Archer and Pierrehumbert, (2011); Myles Allen (2015). One way in which government can mitigate the effects of climate change is to implement a green building strategy, especially green leasing. The significant and negative impacts on the environment caused by buildings inspired the emerging concept of green buildings, designed to be energy and water efficient, use non-hazardous materials and provide a healthy productive environment for employees Intergovernmental Panel on Climate Change (IPCC, 2014). This chapter seeks to provide an introduction to the qualitative study which investigate how professional engineers in the Department of Public Works in KZN consider the green building as a strategy in choosing space for government use. Accordingly, the chapter begins by discussing the background of the study, the motivation of the study, research

problem, research objective and research questions, the significance of the study, the research methodology, delimitation of the research and outline of all the chapters in this study.

1.2 BACKGROUND OF THE STUDY

Green Building is a practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle, from siting to design, construction, operation, maintenance, renovation and deconstruction. In South Africa, the Department of Public Works launched its green building policy in 2018, which discuss increasing the efficiency of buildings, supporting sustainable construction and green leasing. As the government is one of the largest tenants for office spaces in South Africa, it is essential to note that "green lease" is one way in which government may mitigate the effects of climate change. In other words, government green lease of a commercial building for use by government departments relates to how a building is to be occupied, operated and managed in a sustainable way (Rogelj, Den Elzen, Höhne, Fransen, Fekete, Winkler, Schaeffer, Sha, Riahi and Meinshausen, 2016).

The Minister of Environmental Affairs, Mrs Edna Molewa, signed the Paris Agreement on climate change at the United Nations in New York, April 2016. According to Rogelj et al. (2016), the agreement advocate for the green practices in the construction industry that can bring in transformation and add value to global environmental sustainability, particularly in finding the alternative ways to lessen the use of natural resource consumption and energy-intensive materials like cement, steel, aggregates and aluminium. For example, the notion of green office is not about the colour of the office space walls, but the desire of business owners and managers to be socially and environmentally responsible. In the private sector, tenants are beginning to insist on more environmentally friendly office space. As the principle of energy efficiency is now deeply embedded in the culture of commercial real estate, the question of how government select its office space is critical, especially that government is one of the most prominent tenants in South Africa. In implementing the green building strategy, the green office incorporates design, construction and operational practices that significantly reduces or eliminates adverse impacts on the Environment and its occupants. The green office space used by the government is an opportunity to use resources efficiently while creating healthier environments to live and work for public servants.

Government practices regarding green building are fundamental as the catastrophic effects of climate change are everywhere, the real consequences on people's lives are eminent (Boko, Niang, Nyong, Vogel, Githeko, Medany, Osman-Elasha, Tabo and Yanda, 2018). The notion of "green lease" was first developed in Australia where its use became mandatory from 2006 in all Government-owned and occupied buildings. Subsequently, the green lease has expanded into the private sector around the world as a voluntary initiative. It is now being implemented in commercial property lease arrangements in many countries, including South Africa. Green lease enables landlords and tenants to meet the regulatory requirements of a sustainable environment. It is also perceived to be of genuine long term benefit to the environment as it ensures that sustainable developments are occupied, operated and managed following their design. Mindful that government launched a green building policy in 2018, the question of how this policy is interpreted into action is attractive to scholars of strategy and green building in South Africa. It is noteworthy that the common barriers to GB mainly include financial pressure, technical limitations, and inadequate promotion. Furthermore, the lack of motivations from owners" and "high initial cost" are ranked as the top two barriers to green building. The researchers Shen, Tang, Siripanan, Lei, Duffield, and Hui (2018) cited that the market demand and technological advancement are fundamental drivers for the GB industry, and the government, economic conditions, education, and corporate social responsibility are the other stimuli for the green building industry. According to the International Finance Corporation online poll report, Nath, Nayak and Goel (2014) conducted by Asian Green Buildings Council stated that some of the critical barriers to implementing the GB include:

- Government Incentives and Regulations as the main challenge for green building advancement - 51,3%
- High Capital Costs and Green Funds 23,6%
- Market Awareness 16,7%
- Resource and Skill Gap 5,6%
- and others 2,8%

This study focuses on how the green building strategy is implemented in the province of KwaZulu Natal in South Africa. At both national and provincial levels, it is the Department of Public Works which is responsible for selecting office space for the various government departments. This study focuses on the KZN Department of Public Works, which is the largest property owner for state immovable assets. The size of the government's portfolio of immovable assets makes it a significant player in the built environment. Professional engineers

in the Department of Public Works are the ones involved in selecting office space according to the needs of departments. Mindful that the notion of green building and green leasing is relatively new, it is interesting to find out from professional engineers what they consider in selecting office space for the government. The shortage of relevant skills and competency regarding the energy-efficient buildings and technical designs for GB is a challenge in many countries. Built environment industry and government must create a platform that endeavours to close the gap through the skills development programmes to capacitate and equip the labour market (Ghaffarian Hoseini et al., 2013).

Green building practice can be achieved depending on Public Works and relevant stakeholders to retort to global warming goals effectively. Also, managing inevitable climate change impacts through interventions that build and sustain South Africa's social, economic and environmental resilience and emergency response capacity. It is important to note that research and development of the green building are still in its infancy. Hence there is a need for more scholarly research on how green building strategy can be implemented, especially in the public sector.

1.3 PROBLEM STATEMENT

The challenge of selecting green building offices for leasing by the government in KZN is enormous, as it involves a variety of stakeholders (e.g. building inspectors, government departments as tenants, property owners). The unique set of capabilities if the green building is to be a crucial part of mitigating climate change by the government. The government department in KZN can reduce climate change by using "green buildings" or office spaces designed to be energy and water efficient, use non-hazardous materials and provide healthy, productive environments. It is notable that green buildings consume energy less than half of what a conventional structure does, and also use less potable water. Green building can have a significant impact on resource consumption and on combating global warming. Other scholars assert that critical issues regarding buildings and office space in terms of sustainability also include waste management and indoor ecology. While the Government in KZN is one of the largest property owners and tenants in the office space market, it is not clear what aspects of green building are considered when selecting office space for various government departments. As reiterated by Slabbert (2013), the built environment has a considerable impact on the natural environment, economy and human health across the globe. By prioritizing the green building strategy, the conservative nature/environment will be realized by all stakeholders, the health of

the tenants will be improved and growth on savings which contribute to the economy (Slabbert, 2013).

Furthermore, it is important to highlight that buildings have a significant impact on the health and well-being of people and the earth (Kibert, 2012). The Green Building Council South Africa developed a series of Green Star SA rating tools that set the standards for green building and provides clear guidelines on what constitutes a green building. (GBCSA, 2018). According to GBCSA (2018) report to this stage, the council certified only nine government buildings in the whole country. The report by Habitat (2019) indicated that the buildings contribute significantly towards the global greenhouse gas emission. However, less attention is paid to the operational activities of the buildings, which contributes 80 percent and more towards greenhouse emission (IPCC, 2014). Zhao, Fang, Pan, Xu and Zhang (2017) suggest that if the organization focus and invest in facilities management, it contribute positively to decrease the energy consumption, water efficiency and overall performance towards the sustainable Environment.

To prevent the disastrous effects of global climate change and minimize other negative environmental impacts, it is therefore imperative to address the consequences caused by buildings on the Environment by focusing on green construction and green leasing by stakeholders such as government (Initiative, 2014). (Myles Allen, 2015). In KZN, the Department of Public works is responsible for engineering, construction and leasing of office space for government use. In the Department of Public works, it is the professional engineers who are responsible for selecting buildings and office space for the government to use.

Currently, no study has been conducted in KZN to explore what professional engineers from the Department of Public works consider when selecting office space for the government as part of a green building strategy. As issues of green building are new in many developing countries such as South Africa, there is a need for human capital with green technical capabilities to turn green building strategy into action (Nicolson, 2010). In this study, a green building strategy entrenches the practices developed to reduce waste and conserve energy in the workplace or home.

1.4 RESEARCH OBJECTIVES

In this qualitative study, the following were the key research objectives:

1. To investigate how professional engineers in the Department of Public Works in KZN consider the green building as a strategy in choosing space for government use.
2. To explore the capabilities of professional engineers that are key for the Department of Public Works to implement green building strategy in KZN effectively.
3. To recommend the strategy for green buildings within the public sector in KZN

1.5 RESEARCH QUESTIONS

In line with the research objectives stated above, the key research questions addressed in this study are:

1. How do professional engineers in the Department of Public Works consider the green building as a strategy in choosing space for government use?
2. What are the capabilities of professional engineers key for the Department of Public Works to effectively implement green building strategy in KZN?
3. What do professional engineers recommend as the strategy within the public sector in KZN?

1.6 SIGNIFICANCE OF THE STUDY

The study is significant to strategy scholars as it illuminates the key capabilities necessary for professional engineers if they are to implement the green building strategy in the public sector effectively. It is also essential that the study has revealed existing gaps in the current capabilities of professional engineers. This is useful to human resource practitioners to build the green technical skills necessary for professional engineers to implement the green building strategy in the public sector effectively.

Furthermore, the study has indicated that professional engineers on their own cannot adequately implement the green building strategy without knowledgeable clients on green building. It is therefore crucial that effort by professional engineers should include the education of departments to be aware and supportive of green building strategy. In this way, green literacy and public green building education matters for civil servants who are building

consumers and occupants. The civil servants who occupy the buildings may benefit from green buildings and also be agents of change for resource conservation measures such as energy efficiency and material recycling.

1.7 RESEARCH METHODOLOGY

This study has adopted a qualitative approach understanding the various perspectives of professional engineers on what they consider in selecting office space for government occupation in KZN.

1.7.1. Research Design

In this study, the exploratory strategy is used. In this case, exploratory research seeks to understand the nature of a problem when there are few studies conducted to answer the questions of the proposed study (Sekaran and Bougie, 2016a). Exploratory studies are also necessary when facts are known, but there is a need to gather more information to create a viable theoretical framework (Marshall and Rossman, 2016). The data collection method selected for this study was a semi-structured interview. According to Sekaran and Bougie (2016a), the semi-structured interviews are useful in carrying out qualitative research because they allow open, natural discussion to flow between participant and researcher, enabling the latter to gather opinions and perspectives in a relatively short period.

1.7.2. Target Population

Zhao,Tian,Cai,Claggett and Wei (2013) defines the target population as a large number of the group or an event that the researcher is keen to investigate. According to Johnson,Chatrani,Taylor-Christmas,Choo-Kang,Smikle,Wright-Pascoe,Phillips and Reid (2014), a population refers to an entire collection of units or of individuals in a specific area where the research is to be conducted. In this study, the target population relates to 10 professional engineers of KZN Public Works who choose office space for government use.

1.7.3. Sampling

Once the population defined, the sampling method is selected. Non-probability purposive sampling was used in this study. The researcher employed this technique, and it elucidates that not all elements in a population have probabilities of being chosen for the research study. According to Sekaran and Bougie (2016a), non-probability purposive sampling is used when sampling is restricted to specific groups of people that can provide the desired information to

the researcher. The sampling is confined to particular groups of individuals because only these individuals have the required information for the study. Purposive sampling involves a choice of subjects that are in the best position to provide the information necessary (Marshall and Rossman, 2016). Purposive sampling is used when a limited number of people have the information that is sought by the researcher (Sekaran and Bougie, 2016a).

In this study, the participants were professional engineers - individuals with expert knowledge, and hands-on experiences of selecting office space for occupation by government departments in KZN.

1.7.4. Data Analysis

Data were analyzed using thematic analysis (Creswell and Plano Clark, 2007). The thematic analysis involves drawing patterns of experiences from the transcribed conversations which are coded and developed into themes using constant comparison technique. In this way, thematic analysis is “a method of identifying, analyzing and reporting themes or patterns within data”. The purpose of thematic analysis is to search through data to identify any recurrent patterns.

1.8 DELIMITATIONS OF THE STUDY

The study is delimited in two ways. First, the study has deliberately focused on professional engineers from the Department of Public Works who inspect and select building for government departments to occupy. The professional engineers present views on the selection process, consequently excluding the views of the occupants of the selected spaces. In this way, the study has deliberately not included the opinions of the users of the chosen areas, which are the government departments. Secondly, the study has not focused on all professional engineers in the public sector, but only those in based in KZN.

1.9 CHAPTER OUTLINE

The outline of the chapters in this study will be presented as depicted below in table 1.1.

Table 1.1: Chapter outline

Chapter title	Description
Chapter 1	Introduction
Chapter 2	Literature review
Chapter 3	Research methodology
Chapter 4	Research findings
Chapter 5	Discussions of findings
Chapter 6	Conclusion and recommendation

1.10 CHAPTER SUMMARY

This chapter has discussed the background of the study and the research problem. Furthermore, the chapter has presented the research objectives, research questions and methodology used in this study. In the next chapter, the literature relating to Green buildings as a strategy is discussed.

CHAPTER 2: GREEN BUILDING AS A STRATEGY TO MITIGATE CLIMATE CHANGE

2.1 INTRODUCTION

This chapter aims to discuss literature on green building as a strategy to contribute to the mitigation of climate change. In achieving this aim, the chapter will start by focusing on strategy and capabilities to manage green buildings.

After that, the focus will shift to green building as a particular strategy for the organization to mitigate the impact of climate change. Lastly, the chapter will discuss green building as a strategy to mitigate climate change before summarizing the chapter.

2.2 UNDERSTANDING THE CONCEPT OF STRATEGY AND CAPABILITIES

As this study seeks to understand what aspects of green building are considered by professional engineers when selecting office space for government, it is essential to understand the concept of strategy in general initially.

2.2.1 Origin and Meaning of Strategy

According to Gavetti and Rivkin (2007), the term strategy originated from the Greek word 'strategos' which connotes the art of the general. In this case, the chief commander would draft the strategy as a plan of war to defeat the enemy. The concept of strategy assists in comprehending the origins and the evolution of policy as a concept over time. The strategy has evolved right from the 3000 BC during the 'fall of the Greek states', through to the 'Roman Empire' after World War II'. Whether in the army or in business strategy, a strategy sometimes means one's game plan to navigate the Environment one is operating in to realize a certain set future (Winter, 2012).

Chandler (1962) defined strategy as the identification of long-term goals and objectives that the organization set to stay competitive, and this is accompanied by the course of actions and the allocation of resources essential for carrying out these goals. The work of Mintzberg (1987a) has proposed five P's of strategy to reveal the complexity of this concept. The old but useful work of Mintzberg (1978) developed 5 P's of strategy, which are insightful in understanding the phenomenon of strategy in research. In the words of Mintzberg (1978) strategy is defined in different ways as [1] Pattern; [2] Plan; [3] Position; [4] Ploy; and [5] Perspective. These definitions are indicated in figure 1 and elaborated below.

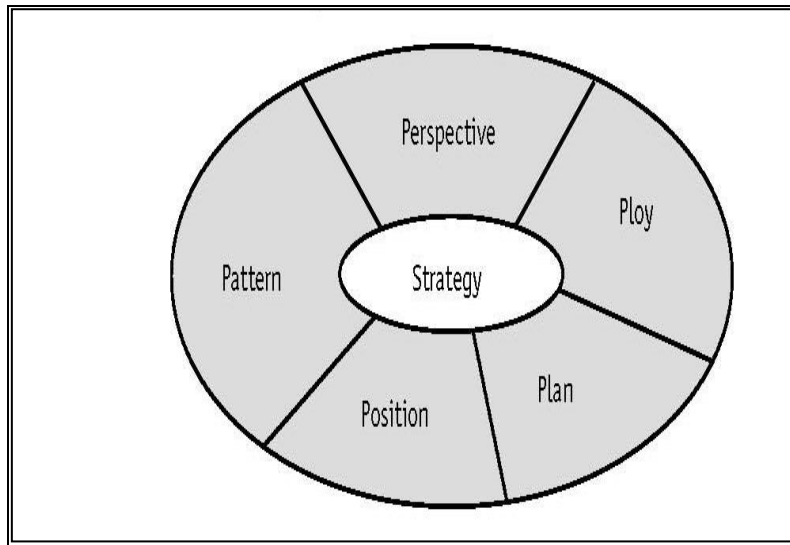


Figure 2.1: P's of Strategy

Source: Louw and Venter, 2010

Strategy as Plan

According to Mintzberg (1978), strategy is a plan that is consciously and purposefully developed to execute the actions intended to be implemented by the organization to achieve the goals and objectives. Strategy as a plan gives overall, conscious direction and proposed course of action into the future on how to deal with a situation (Mintzberg, 1978). In other words, strategy as a plan connotes an abstract and future orientation in dealing with an imagined and anticipated situation or future reality. As alluded in the first chapter, the government in South Africa has a green building policy which may be considered as a plan which reflects how the government seeks to mitigate climate change through green building. The previous utterance resonates with the three elements of strategy, namely, long term, direction and organization (Johnson et al. (2017).

Strategy as a Ploy

Strategy as a **ploy** refers to a “narrower plan” (set of coordinated action to realize intent that is part of the plan) to outmanoeuvre opponents. Mintzberg and Quinn (1996:13) put it, strategy as a ploy is specific with the sole purpose of outwitting a competitor. Mintzberg (1987) explains that the strategy as a ploy focuses on to the culmination of direct competition, this may be by plotting the disruption, dissuading, discouraging and various other manoeuvres applied to gain competitive advantage. This part of the strategy mainly formed to annoy and provoke the counterparts and rivalry in the industry. This strategy is more prevalent in the private sector wherein the competition is rife, and the businesses fight for their existence. In the case of

implementing green building in South Africa, this competitive view of strategy is not very relevant.

Strategy as Position

Strategy may also be viewed as a position for the company or organization in its Environment. In the competitive world, an organization creates a place for itself concerning its competitors and other external stakeholders through a targeted plan. Alternatively, the position may emerge through a pattern of behaviour or outcome of either a proactive or reactive endeavour to create a fit between the firm and the Environment (Mintzberg, 1985:17-18). This part of the strategy deals with how the organization has positioned itself in the market place.

Strategy as a Perspective

The definition of strategy as perspective refers to the organizational way of doing things, the fundamental way in which staff see the world, identify their organization from inside and see themselves as embedded in or guided by the culture and ideology (Louw and Venter, 2010).

Strategy as Pattern

A strategy is also viewed as a pattern evident in emergent decisions, not purposeful, intended outcomes of a pre-conceived plan (Mintzberg and Waters, 1985:257). To be precise, the strategy is the consistent pattern, which emerges over time from a series of decisions. The strategy sometimes emerges from the past organizational behaviour, unlike the ploy and plan which define strategy as the intentional choice and pattern of the consequences (Mintzberg, 1987).

In this particular study that investigates how professional engineers translated the green building strategy in action through green releasing, the notion of strategy as a “pattern” is interesting to understand the pattern of consistent and inconsistent decisions and behaviour evident in the selection of office space for government use. This study will not focus on strategy as a plan but rather a pattern of decisions and actions taken by professional engineers from DPW in KZN as they selected office space for government departments. A pattern may also be delineated to reflect the variety of capabilities which professional engineers have or do not have and impacts on the implementation of green building as a government strategy to mitigate climate change. The next section discusses the phenomenon of deliberate and emergent strategy.

Deliberate and Emergent Strategy

Notably, the strategy is not static as it changes in response to changing internal and external environment, e.g. revised as new information comes available; develops on a continuum between full intention by management and pure emergence despite intention or in the absence of it (Mintzberg, 2014).

Aaltonen and Ikavalko (2002:415) agree that in reality, some strategies are planned, and some just emerge from the action and decisions of organizational members. In a slightly different vein, Mintzberg (2014) suggests that strategy can be categorized into the following [1] Deliberate (intended strategies that are realized) strategies [2] Unrealized (intended strategies but not realized) strategies and [3] Emergent (recognized strategies that were never intended) strategies. These definitions indicated above are elaborated in figure 3 below: According to Louw and Venter (2011) recorded three typologies define strategy as depicted in a diagram below:

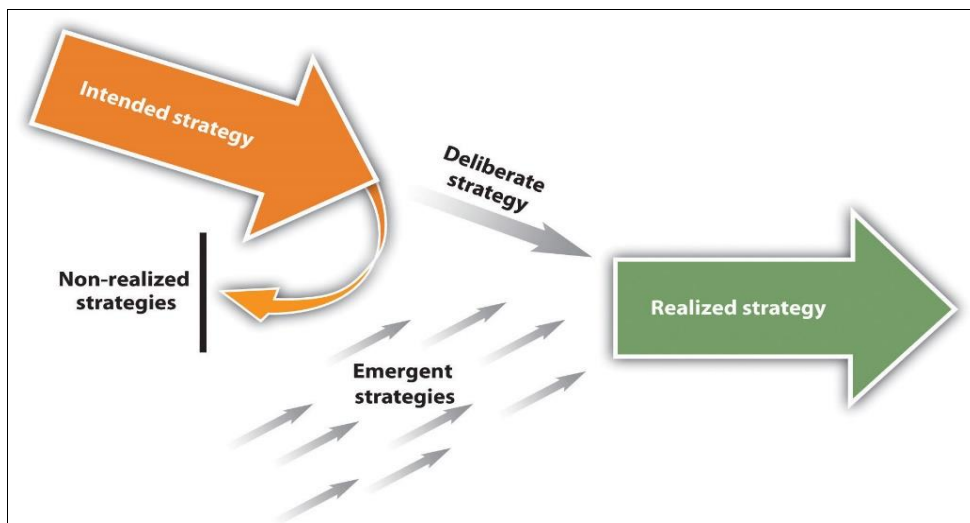


Figure 2.2: Typologies of strategy

Source: Mintzberg and Waters (1985)

Extracted from the diagram, the strategy typologies are listed below in bullet form:

- 1) Deliberate strategy (an intended strategy that is realized)
- 2) Unrealized strategy (planned strategy but unrealized)

3) Emergent strategy (realized strategy that never intended)

1. Deliberate strategies

Mintzberg and Waters (1985) defined unrealized strategies as part of the initially intended plan that were abandoned along the way. The responsibility of managers is to assess the sections of the strategy rejected and failed. It can either be by the organization or even the external environment in the market. Such should be embraced as a source of learning to improve in the future.

2. Emergent strategy

Emergent strategy connoted as a realized strategy. An emergent strategy or realized strategy differs from a projected strategy. Mintzberg (1987) contends that strategy emerges as intentions overwhelmed by the changes in the Environment and embrace reality. This strategy provides an opportunity for the organization to learn what works in practice.

The emergent strategy does not suggest that the management is out of control. It, however, encourage managers and employees to demonstrate flexibility, responsiveness and the willingness to learn especially in an environment that is volatile, complex to comprehend or even hard to ignore. Additionally, Mirabeau and Maguire (2014) mentioned that planned strategy and realized strategy or emergent strategy evolve hand in hand and affect each other in the process of strategy implementation, especially in platforms where strategies are communicated, interpreted, adopted and enacted. In this study, the selection of space for government use as part of green building strategy implementation means “whatever was done (planned) and also emerged (emergent strategy) in the course of green leasing for government offices in KZN. The next section focuses on the concept of capability as it is critical in any strategy implementation.

2.2.2. Capabilities to manage green buildings and green leasing

Green Building has globally been adopted for sustainable development by enhancing resource efficiency, reducing the operation cost, and improving the building environment for users. There is limited research which has explored the capabilities (e.g. green technical capabilities) that are necessary to implement green building strategy, especially in the public sector. In light of this, it is imperative to understand the meaning of the key concept of capability initially.

2.2.2.1. Definition of Capabilities

There is a variety of definitions of capability which are decipherable from literature. Johnson, Scholes and Whittington (2008), view the capability as a method an organization deploy to leverage its assets. As an organizational level phenomenon, the capability is the attributes of an organization, such as financial, physical, and individual/corporate capital, that enable it to exploit its resources in implementing strategies.

Some scholars view capability at the individual level. In this way, capability means characteristics, abilities and resources that facilitate a specific, or predictable response. In the context of human capital, capability represents performing or achieving certain actions/outcomes in terms of the intersection of capacity and ability (Adamson and organization, 2009). This study adopts the definition of capabilities offered by Johnson et al. (2017:98) who differentiates resources and capabilities. Thus, it is essential first to understand that resources are the assets that an organization or an individual have or can rely on. At the same time, capabilities are the ways those assets are used or deployed. In a nutshell, Johnson et al (2017) are explicit that resources are “what we have” while capabilities are “what we do well”. This study focuses on the capabilities of professional engineers which are considered as key in implementing green building as a government strategy for mitigating climate change in KZN. In this respect, it is crucial to understand the concept of capability further by discussing the types of capabilities.

2.2.2.2 Types of Capabilities

Johnson et al. (2008) argue that capabilities and resources are essential in any organization to achieve its strategic objectives. According to Johnson et al. (2008), the two types of capabilities include threshold and dynamic capabilities which are discussed below:

- Threshold capabilities – these are essential for the organization in the segmented niche market to attain the parity with the opponents. Pearce, Robinson and Subramanian (2000) argue that while threshold resources and capabilities are significant, they do not entirely create the conducive environment for lasting competitive and distinctive advantage. It is critical to underscore that threshold capabilities are mainly ‘qualifiers’ to be able to compete with opponents (Johnson, Whittington, Scholes, Angwin and Regnér, 2011).

- Distinctive capabilities – these give the distinctiveness and uniqueness to the organization through the value it provides to its clients, and further underpin the competitiveness advantage in the market (Johnson et al., 2008). It is important to highlight that competitors find distinctive capabilities challenging to imitate and copy as such, these capabilities give the organization the advantage to stay distinctive for long in the market. Grant (1991) assert that dynamic capabilities relate to the ability to renew and restructure resource to meet the needs of changing environments.

2.2.2.3 Capabilities to manage Public buildings

It is pragmatic that the public sector in any part of the world, is perceived as the largest property owners and the richest in immovable assets. In South Africa, the Department of Public Works is the custodian of the Immovable Asset Register (IAR) on behalf of the government as a whole (Buys and Tonono, 2007). According to SA (2019), the Department reported that as of 31 March 2017, the government assets register on property portfolio equates approximately to 29 322 and 93 943 unregistered land parcels. The total value of assets under the custodianship of the DPW is about R139 billion value. Notably, SA (2019) opined that there are apprehensions about the accuracy and reliability of government existing assets register, it is alleged that they are discrepancies and overlapping of functions between the Department of Rural Development and Department of Public Works. The registered assets of government are characterized by the property such as land, public corporate buildings, ministry buildings, government parastatal-owned office complexes, and general, commercial centres (Works, 2006)

Taking into consideration that the public buildings hold significant value, there must be Facilities Management systems in place to maintain the properties in a state that it would enhance the value of the facilities (Odediran, Gbadegesin and Babalola, 2015). Furthermore, to create a functional and safe environment that is conducive for the tenants to keep it in efficient working order, in a good state of repair that would portray the image of the facility in an appealing and enticing to the external environment.

Organizations and institutions often fail to recognize the importance of FM to their business performance and success (Lavy, 2008). FM as a practice has grown from what was traditionally perceived to be the mere managing of buildings or maintenance unit of an organization to the holistic reality of being woven into the core and support services of organizations (Price, Pitt and Tucker, 2011). Facilities management skills are essential as they involve guiding and managing the operations and maintenance of buildings, precincts and community infrastructure on behalf of property or facility owners to achieve a better output at a reduced cost with a higher level of professionalism (Ogungbile, 2015). Furthermore, effective property management may reduce operating costs, dispose of excess properties or hold on troubled properties instead improve their operating income by including them on annual financial statements as part of the immovable asset with resale value. According to the Department of Public Works (2006: 9) in the context of the South African public sector, the cost of not maintaining infrastructure is no longer affordable. They continue by stating that it is refuting the impact of the infrastructure development undertaken to date and planned for the future. The above statement indicates the importance of maintenance of infrastructure and built facilities, as described by the Department of Public Works (2006: 9) maintenance of infrastructure lends itself towards ensuring an adequate quality of life and supports the economy of the country.

The Minister of Health in Southern Africa, Mrs Nkosazana Dlamini-Zuma mentioned that the existing hospital facilities are in poor condition (Institute, 2010). Government has also confirmed that the health facility in Gauteng have been assessed and are not in compliance with health safety standards as set out in the Occupational Health and Safety Act (OHSA) (Institute, 2010). It is important to note that while government buildings have a practical use, they are expected to be in line with green building standards if they are to contribute to the mitigation effects of climate change. It is, however, noted that the state of facilities management awareness and practices is higher in private buildings than it is in public buildings.

Ogungbile (2015) Opined that the infrastructure of the public buildings deteriorated over the years due to various circumstances such as insufficient fund allocation towards the facilities management, the occupant's negligence and the culture of poor maintenance of the buildings that prevails through poor handling and misuse of the facilities. In some instances, the issue is contributed by the age of the building, over-population and the lack of competent and skilled personnel in facilities management (Odediran et al., 2015).

The report by Habitat (2019) indicated that the buildings contribute significantly towards the global greenhouse gas emission. It is estimated that much of one-third of most worldly buildings. There is insignificant attention given to the operational activities of the buildings, which is the part that contributes 80 percent and more towards greenhouse emission (IPCC, 2014). Zhao,Fan,Pan,Xu and Zhang (2017) suggested that if the organization focus and invest in facilities management, it improves and contributes positively to decrease the energy consumption, water usage and overall performance towards a sustainable environment.

The emerging discussions in South Africa regarding the National Health Insurance has triggered another debate on the state of maintenance and infrastructure in government (Bateman, 2012). The government needs to relook on the current practices in managing the development and maintenance of public buildings which seemed to be ineffective and poorly supervised. To have the buildings that are in a good state and well maintained attract the young skilled professional with critical skills and also to be in a position to retain the creative class of old professionals (Zhao,He,Johnson,Mou and Reviews, 2015). However, the scenario is not only with SA government, according to the report opined by Ogungbile (2015) the public sector buildings in Nigeria and Malaysia suffer from negligence by the occupants and the poor maintenance by the respective government department. In this case, there is a lack of green behaviour by occupants of government buildings which requires green building knowledge. In contrast, the facilities management services observed to thrive in the private sector (Kamaruzzaman and Zawawi, 2010). A more robust, systemic and cost-effective approach is required in the public sector to improve the maintenance of buildings which, in some instances, due to negligence, had the detrimental consequences to the government. Additionally, the lack of capacity continues to prevail as a challenge due to inadequate maintenance budgets because maintenance is not prioritized in planning and during the budgeting process. And insufficient technical skills and experience to plan and implement appropriate maintenance programmes still lack in government (Works, 2006).

2.3 GREEN BUILDING AS A STRATEGY

Buildings and Construction industry over the years harmed social, environmental, and economy in the world (Sharma,Saxena,Sethi and Shree, 2011). The buildings are one amongst many aspects of the construction industry; the impacts of building towards the environment are mostly borne during its life-cycle (Sharma et al., 2011).

Song and Zhang (2018) uttered that the construction industry consumes about 24% of the world's raw materials and a significant amount of energy. The old styled building materials, which include steel, aluminium, glass and concrete, are the type of materials that are high on energy. Furthermore, the choice of materials used during the construction will, in turn, significantly affect the performance of the building during its life cycle. The selection of building material and manufacturing low energy material have been re-iterated by many authors as important than building operating energy (Song and Zhang, 2018).

The Statistician-General Risenga Maluleke revealed that the South African population has risen to 58.8 million since 2018 (L'Abbé,Loots and Meiring, 2005). The rapid growth on population would have a detrimental effect on the environment due to the increasing demand on buildings, the expansion on Infrastructure and the over-urbanization.

In general, the conventional building's usage of global energy is more than 40% during the operational life-cycle (Young, 2018). Furthermore, timber usage globally is approximately 70% compared to raw materials and estimated 15% of the earth water resources and a significant tremendous amount of waste generated which contribute to the environmental degradation (Thilakaratne and Lew, 2011).

In South Africa, the operation of the building sector accounts for 23% of greenhouse gas emissions. Accordingly, the gas emissions from the manufacture of the primary materials for the building sector amounts to around 18mtCO₂ per year, or approximately 4% of total CO₂ emissions (CIDB, 2009).

The detrimental impacts caused by the buildings and construction activities are somehow not fully acknowledged by the authorities (IPCC, 2014). According to Environment (2009), these are unanimously the effects which are not limited to the production of noise, inconvenience caused by traffic commotion, dust, wastage of water and waste disposal during the construction phase. Once completed, during their life cycle, the buildings continue to be harmful to the environment. According to the World Business Council for Sustainable Development, building block equates to 40% of total energy consumption (Elkington, 1994).

Contrary to the adverse effects to the environment caused by the buildings, they are however, the positive economic impacts contributed by the construction industry (Environment, 2009). The construction sector has contributed significantly to the urbanization across the world, through the buildings and facilities to meet the human being's requirements, creating the job opportunities directly and indirectly during the business relations with other industries related to the construction sector and also contributing to the economic growth (Cohen, 2015). In South Africa, the construction and infrastructure industry contribute 29,7 percent towards the gross domestic products (GDP), as at from January 2019 till September 2019. The construction industry contributes immensely to the economic growth of South Africa, which resulted in the creation of employment. However, the sector experienced a downward slope on growth since the soccer projects executed in preparation for holding the world cup in 2010. The industry in 2015 experienced a financial dilemma, wherein it was adversely impacted by the metal-workers strike in July 2014 and subsequently the labour unrest of the employees and at clients and suppliers (Environment, 2009). All of this resulted in delays on most essential projects in the country.

The concept of green building developed from the green movement between 1970 to 1980 as an answer to meet building demand while reducing the construction industry impact to the environment due to the energy consumption and water wastage (Nguyen, Skitmore, Gray, Zhang, Olanipekun and Recycling, 2017).

Accordingly, the Environmental Protection Agency in the United States elucidate the concept as green construction and sustainable buildings, this attests to the orbit that is environmentally responsible and maximizing the efficiency of the resources even throughout the building life-cycle (Initiative, 2014). This process starts from designing, the construction, daily operations and maintenance, renovation and demolition (Hoffman, Henn and Environment, 2008). Conversely, according to the basic requirements of sustainable development in China, green building is defined as a building that, to the greatest extent, saves resources (energy, land, water, materials), protects the environment and reduces pollution throughout the whole life-cycle, so as to provide people with healthy, suitable and efficient use of space, which is also in harmony with nature (Kibert, 2012). Accordingly, this definition as stressed by Nguyen et al. (2017) it emphasizes that more attention should be focused on the green concept in the whole life cycle of a building, which in turn puts forward additional requirements on the implementation of green buildings.

According to Son and Kim (2015), studies have shown that the greening technologies and design applied in GB can increase the efficiency of buildings by up to ten times in terms of resource utilization. The Green building is one of the most effective solutions to increase the efficiency of buildings through resource utilization and recycling, mitigating the negative impact of the construction industry on the environment. The construction nowadays has evolved with adaptation to the embracement of innovation, and the concern is the current barriers observed to have faced the GB to penetrate the market which is traditionally dominated by conventional buildings (Nguyen et al., 2017).

Green building is one of the mitigating strategies with potential if used appropriately to mitigate the epidemic caused by traditional buildings to the society, environment and economy. The GB is designed and built with sustainability standards to last for decades, and it is essential that for its sustainability, it gets to be operated and maintained using the same standards. According to Spence and Mulligan (1995), conventional buildings were not designed and built to meet sustainability standards. Green buildings encompass a variety of attributes and present challenges with regards to adaptation to the sustainable Environment, integrating retrofit measures that lessen energy, water and resource consumption is significant (Wilkinson, 2012).

An ecological approach to design aims to integrate the systems introduced with the existing on-site ecological functions pre-formed by mother nature (Nicolson, 2010). The ecological response to the movements of the sun, purify the air, it catches filter and stores water. According to Cavalcanti (2000), designers can create features in their buildings that mimic the functions of distinct eco-systems, species that thrive in natural ecosystems may also utilize habitats created in human-made structures.

According to Cavalcanti (2000), there are many business benefits for deciding to pursue a strategy for sustainable buildings:

- Lower operating costs which create a high return on investment
- It attracts tenants easily because it is marketable
- It offers more productivity benefits
- Provide healthy Environment for work and external Environment.

Generally, the consumption of electricity in summer would be higher in office buildings due to the usage of a cold ventilation system, and this adds pressure to the overall energy suppliers. Notably, the office buildings are perceived to be the highest types of buildings in energy consumption if compared to other building types (McLaughlin and Nichols, 1994). So, the

landlords must implement specific strategies to decrease energy consumption especially in this type of buildings, by using renewable energy sources such as solar energy, wind energy and other sources which contribute in rechargeable energy rationalization (Wilkinson, 2012). It is suggested that the adaptation of Green Buildings as the strategy simulate the benefits of minor consumption on energy and envelope excellent performance during the winter and hot season climate, where there is an expected pressure on the usage of ventilation system (Son and Kim, 2015).

Accordingly, (Zhao et al., 2017) propose the strategy to adopt the distinct architectural system to reduce the energy consumption in the office buildings which underpins the adaptation of green building strategy. The aspects discussed below may help to consider elements which enhance a green building and its benefits:

- To develop and design a structural system where all the architectural and mechanical design intent to diminish energy consumption.
- To study the type of office building and outer shell, and the use of natural lighting and ventilation. And the provision of vertical landscaping as well as the courtyard.
- Use of renewable energy sources such as wind turbines and photovoltaic systems for the office building to reach its maximum utilization.
- The relationship between architectural form and energy efficiency in the building, to take advantage of wind energy and solar energy.
- Solar buildings are designed to keep Environment comfortable in all seasons without much expenditure on electricity which may bear the savings of 30 percent to 40 percent.

To understand the concept of green building better, Table 1 is a comparison between Green Buildings and Traditional Buildings.

Table 2.1 Comparison between “green buildings” and “traditional buildings.”

Source: Slabbert, 2013

Service Description	Green Building	Non-Green Building/Traditional Buildings
Energy Consumption	Low	High
Indoor Environment quality	Very Good	Good
Emission	Low	High
Waste Management	Highly efficient	Efficient
Building Materials	Environmentally friendly	Not Environmentally friendly
Project Practices	Sophisticated	Normal
Feasibility	>5% than the threshold	threshold

As reiterated by Slabbert (2013), the built environment has a significant impact on the natural environment, economy and human health across the globe. By prioritizing the green building strategy, the conservative of nature/environment will be realized by all stakeholders, the health of the tenants will be improved and growth on savings which contribute to the economy (Slabbert, 2013). Green building strategy entrench the practices developed to reduce waste and conserve energy in the workplace or home. Green construction methods can be integrated into buildings at any stage, from design and construction to renovation and deconstruction (Parry,Carter,Carter,Intergovernmental Panel on Climate and Earthscan, 1998).

2.4. ELEMENTS OF GREEN BUILDINGS

Zigenfus (2008) asserted that due to the limited research conducted, green buildings had generally been cited to be more expensive than conventional buildings. However, elements that contribute to this cost differential had not been discussed. The researcher identifies Green building main elements which are depicted below as follows:

2.4.1. Innovation & Design Process

Innovation and Design Process is distinct as special design methods that allow a structure to become more efficient in resource use and conservation of energy. Innovation and design start with planning and include creative ways to achieve green.

2.4.2. Location & Linkages

The element discusses the site location and linkage of the office building and or home social and environmental responsibility in relations to the broader community.

2.4.3. Sustainable Sites

The sustainable site encourages the use of the building material that requires less of natural resources. Many of the sites use native plants in their landscaping scheme, thereby reducing water demands, recycling of construction waste and labour needed for maintenance.

2.4.4. Water Efficiency

The water-efficient element includes the reduction of water use and elimination for water sources outside the site itself. The control of water runoff from stormwater is also an essential aspect of this element.

2.4.5. Energy & Atmosphere

Energy efficiency and atmosphere element is a concern, particularly in the building envelope heating and cooling design systems. The use of alternate sources of energy such as wind, solar or, thermal energy sources is essential aspects to be integrated into building energy plan.

2.4.6. Material & Resources

Materials and resources are the efficient utilization of materials, selection of environmentally preferable materials, and minimization of waste during construction. Also, the use of recycled materials or materials with recycled content is a crucial aspect of this element.

2.4.7. Indoor Environmental Quality

The element comprises the improvement of indoor air quality by providing indoor comforts such as temperature, noise and light. The interior lighting provided through skylights and windows, control of the lights through manual and automatic controls.

2.4.8. Awareness & Education

Awareness and education provide information to the tenant of the office buildings about the operation and maintenance of the green features of the building.

The Department of Transport and Public Works in Cape Town piloted a green building project for its work on a building completed in 2017 for the Department of Health (Government, 2016). The R128 million regional office building at Karl Bremer Hospital in Bellville became the first recipient of the GBCSA Socio-Economic Category Pilot Award. The building was recognized by the Green Building Council of South Africa (GBCSA). It was also awarded the GBCSA 5-Star Green Star Certified SA rating for the design of a public education building to accommodate 320 civil servants. According to the GBCSA ratings, the five stars awarded to the Department of Transport and Public Works espoused the orthodox of “South African excellence”. This is the first to be awarded to the government department in the country.

According to the Western Cape Government, (2016) the Green Star rating measures the elements such as the design of a building, indoor environmental quality, energy efficiency, location of the site concerning public transport, water efficiency, the use of sustainable building materials, land use and ecology, gas emissions, and innovation. Additionally, the Socio-Economic Award the Department received was because of the green building project which made a significant contribution to employment creation, economic opportunity, skills development and training, community benefit, educational empowerment, as well as health and safety.

2.5. FEATURES OF GREEN BUILDINGS AND OFFICE SPACE

Ghaffarian Hoseini (2013) claims that in recent times the sustainable workspaces are becoming more prominent, and some may even argue that a more energy-efficient building correlates to a more efficient and productive work environment. The picture below indicates the variety of benefits of green offices to the environment and the people.

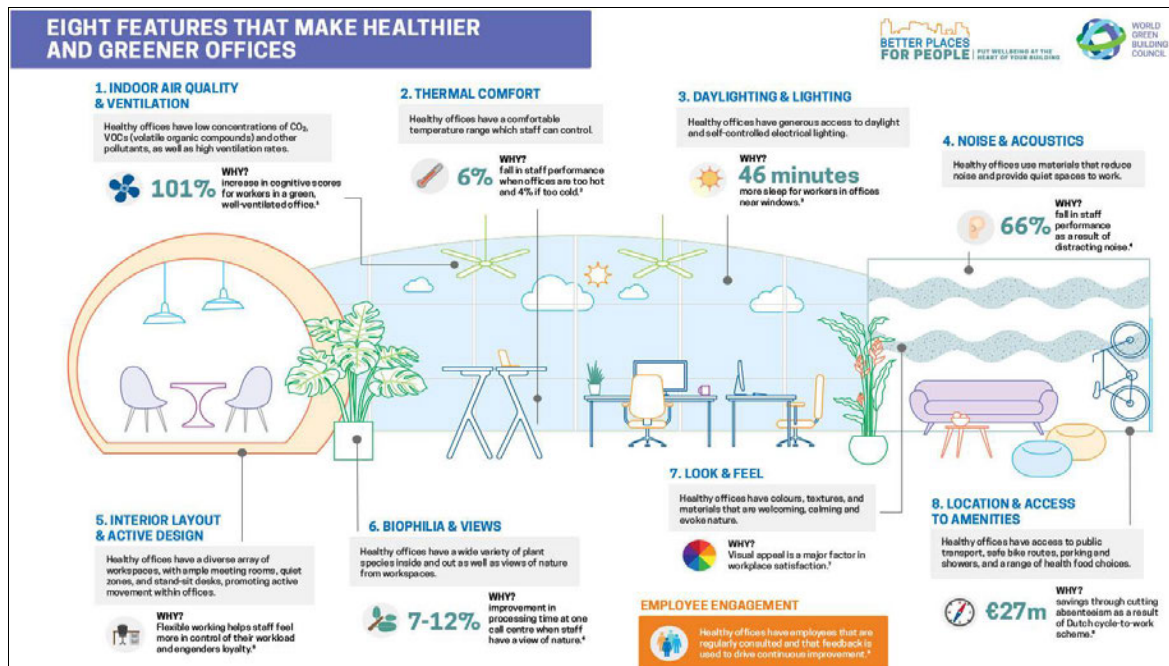


Figure 2.3: Eight features that make healthier and greener offices

Source: (Kibert, 2012)

2.5.1. Energy Efficient Buildings

Habitat (2019) suggested that the business operations should reduce overall energy use at the facility level by managing the energy consumption associated with specific production processes and supporting utilities, which would result in cost savings. A financial institution can assist the clients in identifying areas for reductions in energy use and detecting environmental business opportunities (Juan, 2010). In the context of government, this invokes questions on what aspects of the green building do professional engineers focus on when selecting office space for the government to use.

Table 2.2 Estimates of potential reductions through changes in building management.

Source: Boyle, 2005

Activity	Potential Reduction
Planning	
Increasing urban density	50-90% energy and impacts
Development on marginal lands	40-50% improvement in crop production; reduction of erosion
Integrated urban and architectural design	Improvement in building value
Incorporation of green and open space	Improvement in building value; human Health
Human-powered transportation	90% energy; improvement in human Health
Establishment of mixed-growth managed forest to supply industries	50-80% in energy and impacts
Construction	
Passive solar power	50-90% energy
Local source of materials	50-80% impacts and energy
Use of low energy materials	50-80% energy
Recycling/reusing materials	40% energy; 10-50% impacts and Materials
Water tanks	composting toilets 80-90% external water and energy
Operation	
Low energy	low water appliances 20-50% energy and water
Use of human powered transportation	90% energy; improvement in health
Minimizing water and energy use	10-20% energy and water
Maintaining and refurbishing building	50-80% over 200 years

According to Initiative (2014), most businesses had no proper water waste management system that can reduce the volume of water requiring specialized treatment. The system could be done by improving and modifying production processes, including the use of less hazardous material that contaminates water, and also adapt the practice of treating wastewater on-site before discharging it.

The landlord ought to identify the strategies that are environmentally friendly to underpin the efforts of conserving water. It can be done by improving the operating system that reduces the wastewater generation through water recycling methods to create possible reuse.

As previously discussed, the GB's does not only offer benefits to the natural environment and reduce pandemic of climate change, most importantly they increase the quality of health to those that occupy the buildings and improves building performance.

2.5.2. Green rooftops

Castleton (2010) opined that the green roofs are a reflexive cooling technique that assists the solar radiation to get to reach to the below level of building structure. Additionally, Aziz and Ismail (2011) explain the green roof as a green space that is built on top of the existing human-made structure. It is characterized to have the waterproofing system of high quality. The system is built to be repellent to alien roots, efficient drainage system, lightweight growing plants and filter cloth for reducing the contamination of drinking water.

Green buildings offer an advantage to the engineers to incorporate the green rooftops at the design stage (Aziz and Ismail, 2011). The studies conducted in the past ten (10) years in Berlin suggested that the green rooftops absorb 75% of rainwater, and lessened the discharge to 25% of the normal levels as compared to the traditional buildings (Slabbert, 2013). There is also potential in a case of existing retrofitting buildings for a green roof, and this envisaged to reduce the energy consumption of heat required in winter and the cooling ventilation in summer (Castleton, 2010).

The green roof pilot project (GRPP) is part of eThekweni Municipality's Climate Protection Programme (MCPPE). The programme was initiated in 2004, by eThekweni Municipality's Environmental Planning and Climate Protection Department (EPCPD). The intention was to better understand the vulnerability of the city to the impacts of climate change and to identify appropriate climate change adaptation and mitigation interventions

(Van Niekerk, Greenstone, Hickman and Climate Protection Department: Durban, 2011).

The GRPP aims to explore the potential benefits of green roof habitats in reducing temperatures and stormwater run-off, thereby enhancing the city's adaptive capacity. However, in comparison to cities around the world, such as Singapore, Chicago, Toronto, Tokyo, where the use of green roofs is well developed, experience in the creation of green roof habitats in South Africa, and particularly in Durban, is limited (Van Niekerk et al., 2011).

The rooftop embedded vegetation that assists in protecting the roof from the physical damage such as cracks that may be caused by the eroding building material due to the heat (Johnston and Newton, 2004).

2.5.3. Green Walls

The green wall is one amongst other integrated initiatives that are profitable to mitigate the degradation that continues to be caused by pollution to the environment, especially in the urban areas. It provides for the growing of plants vertically to support the vegetation covering the fronts of building with attractive features on its design that enhance the image of the building (Valesan and Sattler, 2008).

Green walls provide the straight shade of the wall surface by adding to the building insulation as explained by Slabbert (2013) and the cold climate is created through this technique. Furthermore, in summer, the tenants can enjoy the benefits of aesthetical, which psychologically contribute to their wellbeing. In the extreme heat weather conditions, the vegetation assists to minimize the building deterioration (Valesan and Sattler, 2008).

Consequently, Valesan and Sattler (2008) claim that this method creates the burden to the tenants due to the continuous errands on maintenance, the presence of the unsolicited insects is inevitable which has potential to destroy some of the building cosmetics.

2.5.4. Social aspects of Green Building

It has been shown that the benefits of the green building go beyond the environment and economics; it expands to bring in an element of positive social impact as well (E. Gnansounou, 2019). Social sustainability concept encompasses the consequences that may be positive or negative derived from the building systems, the operational processes, the institutional attributes, community development and resilience, human activities and practices, the provision of decent working conditions, and cultural competence (E. Gnansounou, 2019).

According to Bolund and Hunhammar (1999), the human race is fragmented to be part of nature, especially in the cities where the population is rapidly growing. The people form part of the species that form a network of ecosystems. They are various benefits drawn from social sustainability that are contributed by the GB practices, the most common relates to the health and wellbeing of people who occupy and work in these green offices and to the people who live in green homes. (Zhao et al., 2015). It is suggested that the employees who work in green offices, has a potential for their brain to work at an optimal level due to high ventilation system. Accordingly, the research suggests that with a provision of good indoor air quality and less concentration on CO₂ contaminants, this improves the productivity of the employees to approximately 8 per cent (Yoon, 2011).

Another benefit of green buildings is that they have an enticing and sustainable design which has potential to influence the decision making of consumers, moreover the niche of the affluent market held in high regard the advantages of green building. Green buildings fulfil the humanistic needs in relations to the benefits such as high energy performance, human comfort, indoor environmental quality, less greenhouse gas emission and high workplace productivity.

2.5.5. Economic aspects of Green Building

According to Eichholtz, Kok and Quigley (2013) green buildings bring in the proportional value, which is in the form of financial and economic benefits, and these benefit people in different market segmentation. To the tenants and greenhouse occupants, it reduces the costs on utility bills through energy and water efficiency. In other words, green buildings provide value for money to the property developers through the low construction costs and gaining competitive advantage through the importance attached to the property. However, the lack of green building literacy may impede a variety of stakeholders from getting the benefits of green buildings. However, this study focuses on those responsible for assessing the suitability of office space for the government to use. Many organizations have the challenge of high absenteeism of employees at work due to health-related glitches, that lead to lower productivity that may be caused by the discomfort at work, poor ventilation, and poor indoor environment air (Robert, Melissa and Mehmet, 2006).

Zuo and Zhao (2014) state that the economic benefits of green buildings include saving of energy up to 30% on energy consumption. For the building to achieve green building council accreditation of Green 5 star and Green 6 star, the construction costs will increase by 4 to 6% respectively. However, the costs of ignoring going green are high as well with the consequences of high prices of energy and depletion of natural resources for the future generation.

Table 2.3. Advantages of green buildings Source: Soni (2015)

Builder Friendly <ul style="list-style-type: none"> • Cost Competitive • 70% Energy Savings • "Super green" Product • Labor Friendly • Fast Construction 	Engineer Friendly <ul style="list-style-type: none"> • Engineered to meet building codes • 4 Hour fire rating • STC 61 sound rating • Engineered for earthquakes • Engineered for high wind (hurricane/tornado) 	Family Friendly <ul style="list-style-type: none"> • Mice, rodent proof • Mold proof • Spider, "bug" proof • Termite proof • Dry-rot proof
Long-term Savings <ul style="list-style-type: none"> • Immune to water damage • Abuse resistant • Durable • Aesthetically beautiful, no "block look" • Virtually zero "life cycle costs" 	Consistent Performance <ul style="list-style-type: none"> • Water proof • Air tight • Dust free • High quality construction • High security 	Subcontractor Compatibility <ul style="list-style-type: none"> • Excellent below-grade construction • Architecturally friendly • Compatible with virtually all roof systems • Compatible with virtually all other wall systems • Over 100 different applications
International Compatibility <ul style="list-style-type: none"> • Culturally Acceptable • Nearly 3 decades of use domestically and internationally • World class life expectancy • Bullet proof • Very low "risk management" exposure 		

Accordingly, UNEP-WCMC,UK and Gland (2016) claim that the strict measures instituted in buildings on elements such as fuel switching, efficiency on energy consumption, and the use of renewable energy can increase the savings to as much as 84 gigatons of CO₂ by the year 2050.

2.6 Chapter Summary

This chapter has discussed literature on green building as a strategy to contribute to the mitigation of climate change. The chapter has discussed a variety of definitions of strategy and green building. The concepts of capabilities have also been discussed as it is critical in exploring the set of capabilities for professional engineers to implement the green building strategy for government in KZN. The next chapter looks at the research methodology used in this study.

CHAPTER 3: RESEARCH METHODOLOGY

“Research is formalized curiosity. It is poking and prying with a purpose”.

Zora Nearle Hurston

3.1 INTRODUCTION

The chapter starts with a brief outline that elucidates what research and the necessary systematic research process adopted to achieve the aim of the study is. The epistemological approach that the research conducted around outlined. Dutta Roy (2019) suggests that research is a systematic and organised effort, to investigate, to describe, to explain, to predict, and control the observed phenomenon. The process is done through different methods, such as interviews, studying and analysing events, personal experience, observations and many more others.

According to Sekaran and Bougie (2016b) echoed that research conducted as a thorough study to come up with results that assist with finding solutions or answers to questions. The systematic research process described in respect of the sampling process, description of interviewees, data collection procedures, individual interviews, data capturing and data analysis procedures. The chapter also discusses aspects relating to research quality, ethical considerations and limitations of this qualitative study before concluding with a summary.

In light of the above, the chapter begins with a summary of the research onion that is depicted in the diagram below. Subsequently, the research process discussed.

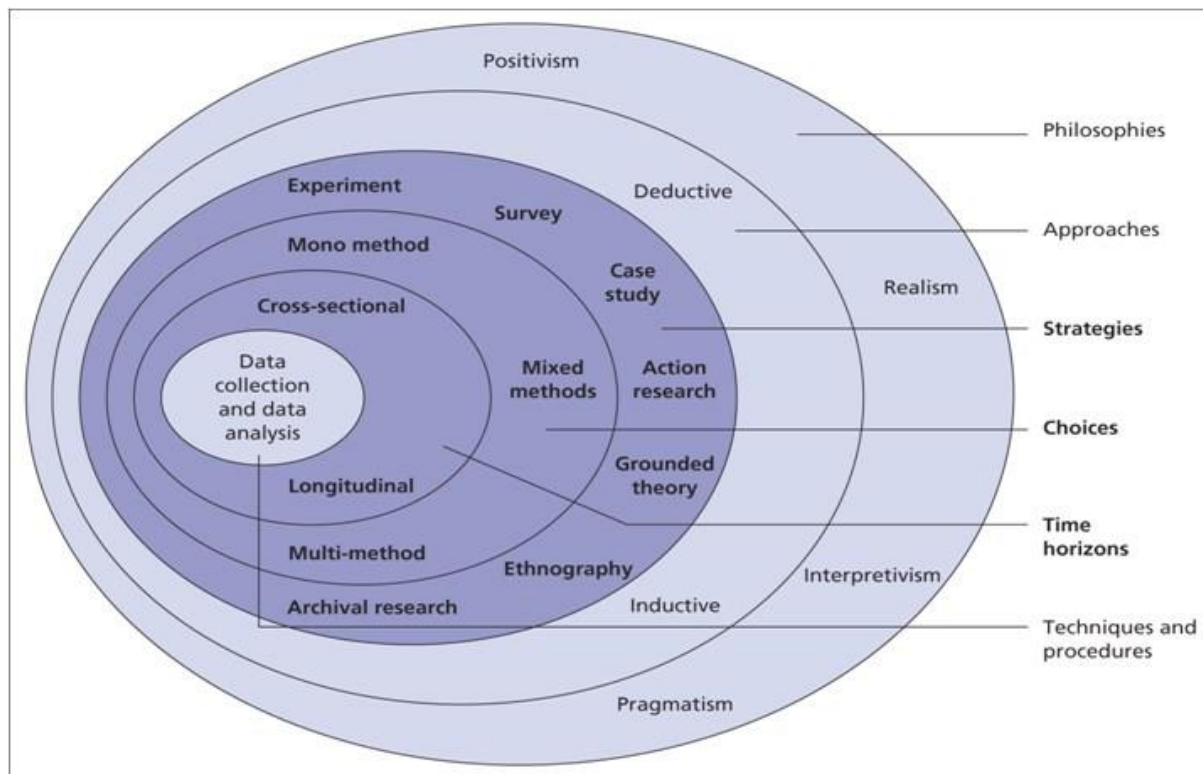


Figure 3.1: Basic Research Onion

Source: Sekaran & Bougie (2013:49)

3.2 RESEARCH PARADIGM/ ESPISTOMOLOGICAL APPROACH

The study is situated around a constructivist/ interpretivist paradigm as the researcher wanted to understand the phenomenon under the study, considering the prior knowledge and some experience encountered. The study focuses on the specific context in which people work and seeks to understand from participants through a gathering of information using the in-depth one on one interviews. After that, the interpretation of the findings presented.

Proponents of constructivism elaborate that it is a theory of observation on how people learn, through their experience on things they have encountered in their journey of life (Grier Reed, Skaar and Parson, 2009). It is common that people view the world and construct their understanding, ideas and knowledge through their past experiences as suggested by (Willig, 2016).

Creswell and Plano Clark (2007) further explains that using interpretive/constructivist it tends to limit the researcher to depend more on the participant's views of the predicament being studied and recognizes the impact on the research of their background and experiences. In this study, the researcher conducts rigorous data collection through the semi-structured interviews to get the lens of professional engineers to understand their reality when implementing green

building as a strategy to mitigate climate change. The research process is mainly inductive, and it is a qualitative study (interviews), with the inquirer frequently conducting research on-site of the participant which gives the privilege to make an observation (Creswell and Plano Clark, 2007).

Creswell (2014) purports that the qualitative research method brings out the significant characteristics as discussed below:

- 1) The study usually is conducted by the researcher who collects and analyse data by interacting with research participants.
- 2) The researcher may use multiple sources to collect data, such as interviews, observations, and documents.

Notably, constructivists do not generally begin with a conclusive theory. Instead, they generate or inductively develop a pattern of wits throughout the research process.

3.3 TARGET POPULATION

The target population refers to as any number of characteristics within a group that the researcher uses to conclude their subject matter, and the population can be general imprecise or specific (Cervantes,Goyache,Molina,Valera and Gutiérrez, 2011). Also, it is the total number of people that has specific characteristics targeted to be available in the participants of this research (Black 2011:89). Accordingly, Ghosh and Kothari (2012) implore target population as denoting a whole gathering unit or individuals that the researcher aimed to engage. In line with the discussions above, the population in this study is the professional engineers who are involved in the technical assessment of buildings for the government to occupy in KZN.

3.4 SAMPLING AND SAMPLING SIZE

A sampling of the study has a profound impact on the outcome of the study, is the selection of research participants from an entire population (Higginbottom, 2004). The KZN Department of Public Works is the institution that the researcher chose to conducts the study, the Department of Public Works (DPW) is the largest property owner since it is mandated and accountable for state immovable assets. The size of government's portfolio of immovable assets makes it a significant player in the built environment. Human resource directorate provided the names, contact numbers and emails to contact professional engineers.

In the selection of the sample for a qualitative study, non- probability purposive sampling strategy was used to select relevant participants in this study. According to Acharya,Prakash,Saxena and Nigam (2013) suggest that non-probability sampling is a sampling technique in which the researcher selects samples based on the subjective judgment of the researcher rather than simple random selection. The researcher applied Purposive/Judgmental sampling strategy for this study, and the participants selected by the researcher based on their attributes, competency, knowledge and credibility relating to the subject of the green building as a strategy to mitigate climate change. A total of 10 participants (the professional engineers from professional services division who are involved in the technical assessment of building for the government to occupy in KZN) participated in individual semi-structured interviews. These were selected because of their hands-on experience of selecting office space for use by the government.

3.5 DATA COLLECTION

Data Collection is another significant integral part of the research study. In-accurate data collection has detrimental results to the study, and it can lead to the unfounded and invalid results of the research (Hammarberg, Kirkman, de Lacey, 2016: 175 - 176). Triangulation is defined by (Carter, Bryant, DiCenso, Blythe and Neville, 2014) is one of the fundamentals used in qualitative research to have a combination of various research methods. It underpins the investigation of the same phenomenon with an effort by the researcher to avoid the weakness of impartiality that maybe with a single method.

Qualitative method is used to get the first-hand data through the open-ended questions and conversation communication between the researcher and the participants. The purpose is to obtain the answers from the questions posed to the participant mainly from their perspectives, experience, point of view, text and analysis on relevant government documents such as policies, acts, reports on the subject matter. For this study, the in-depth interviews will only be the primary method that the researcher will use to collect data due to time constraints.

The enquirer in qualitative research seeks to get the thoughts and feelings of the research participants, which sometimes may be the issues that people may consider personal. In this instance, the vulnerability of the informants must be safeguarded and assured in order to obtain accurate and reliable data as opined by (Pope,Ziebland and Mays, 2000).

The researcher to articulate to the informants the mechanisms in place to safeguard the data collected, moreover before the commencement of the study the approval would have to be obtained from the relevant institutional research ethics council as concurred by (Leung and care, 2015). It is against this backdrop that the researcher, before commencing with the interview, she followed the depicted process:

- the detailed introductory letter that is outlining in full the aim and objectives of the study,
- the approved ethical clearance and,
- the consent form was given to each interviewee and informed that if they feel uncomfortable continuing with the interview, they can withdraw at any time.
- All interviews were audio-recorded; the researcher obtained the consent of the interviewees.

The semi-structured interview guide was developed to ensure that all the espoused research objectives of the study are covered during the interviews. The semi-structured interview guide provided a clear set of instructions for guiding the research informant. The researcher made a prior appointment with each interviewee to confirm the suitable time, date and convenient venue. The interviews were conducted face to face, and this offered an opportunity ask to follow up questions to sort clarity where necessary. The researcher met each professional engineer in various Department of Public Works offices, seven (7) of the participants were in Pietermaritzburg, two (2) were in Durban, and one (1) was in Ladysmith. On average, each interview took 45 minutes. The facial expression of the informants when answering each question was observed to detect the comfortability of the respondent.

3.5.1 Pre-Testing of Interview Guide

Venkatesh, Brown and Bala (2013) suggest that a pre-testing helps to detect probable or potential ambiguity issues with research questions enclosed in an interview guide. During this process the participants may provide relevant and useful information that will assist in correcting the research process issues. The pilot study involved interviewing two (2) participants from the professional services division who were professional engineers within the Department of Public Works using an interview guide. In line with assertions by Angouri (2010), the purpose of conducting the pre-interviewing to the two (2) professional engineers were to detect any possible adverse reactions or uneasiness, with the aim to make corrections before the actual interviews can be conducted. Fortunately, the changes effected in the

interview guide was only related to the correct designation of the participants. The two (2) participants who responded to the pre-testing interview guide were not included in the final interviews, the process is in line with the recommendations by (Bhattacharjee, 2012).

3.5.2 ADMINISTERING SEMI-STRUCTURED INTERVIEWS

All interviewees were based in KwaZulu Natal – Department of Public Works offices in South Africa. The selection criteria used for professional engineers within the professional services included: (1) involvement in the technical assessment and selection of office space for government use in KZN; (2) three years' experience in selecting office space for government departments to use; and (3) willingness to express his or her expertise in details.

Eight of the participants were male while two were females. Four of the participants were in the age of 25-39 years old. Five of the participants were in the age group of 40-60 years. Only one of the participants was over 60 years. The participants were professional engineers who had the following qualifications:

- Four had a diploma qualification in mechanical engineering
- Four had a diploma in electrical engineering
- Two had Master's degree in architecture

3.6 DATA ANALYSIS

The data collected were analysed using thematic analysis method to understand the variety of aspects which professional engineers consider when selecting office space for government in KZN to use. Thematic analysis is “a method of identifying, analyzing and reporting themes or patterns within data. The purpose of thematic analysis is to search through data to identify any recurrent patterns (Bryman, 2012).

Thomas (2008), cited in Royce (2011:165), outlined four steps in qualitative data analysis which are as follows:

1. The conversations, interviews or responses are transcribed and written down.
2. The source material is carefully read, and key segments of text are highlighted.
3. Themes or categories and subcategories are coded (identified).
4. Patterns which make sense of the most important themes or categories are sought. The researcher explains the significance of the themes or categories to the research participants.

3.7 RESEARCH QUALITY

3.7.1 Trustworthiness and Rigor

Connelly (2016) cites that the most common criteria used to evaluate qualitative research are those purported by Lincoln and Guba. The study applied four elements as recommended by Guba and Lincoln's, to support trustworthiness and rigour, which was elaborated as follows:

- Credibility – it is referred to as the authenticity and Truthfulness of the study. Moreover, to ensure that credibility and the truth on findings are at a reasonable level of confidence.
- Applicability, this to ensure that the way the study conducted will make it relevant to be applied, transferred and generalized in any similar context.
- Reliability - creditability is the mother to reliability in qualitative research. Reliability in some cases translated as an attachment, i.e. findings do not retain to a specific time, and if another person who is not involved in the research pursues it, he will reach to the results similar to other previous researcher's findings.
- Neutrality, this to ensure that there is objectivity and no researcher bias on the findings presented.

3.7.2 Credibility

Credibility is essential to the research study, and it requires the researcher to vividly link the study findings with the reality that they may cross-check. Member check was used to allow participants to check the accuracy of the transcripts (Bryman and Becker, 2012).

3.7.3 Transferability

Transferability refers to the extent that research findings are transferable to a different situation or population than that of the initial study (De Vos et al., 2005). Transferability achieved when researchers provide detailed explanations of the context of the research undertaken, such that the readers can assess whether or not the outcomes can be transferred (Shenton, 2004). In this study, the researcher has provided full details on methods, roles, settings, and participants for readers to transfer findings to similar contexts. This type of information can assist any reader in assessing the relevance of the conclusions concerning their unique conditions (Barnes et al. 2012).

3.7.4 Dependability

Dependability is concerned with the consistency of the data, which indicates whether the findings would be consistent if the study were to be repeated with the same subjects in a similar context. The researcher kept the audiotapes, fieldwork notes and transcripts of the data collected to show that proper procedure had been followed. In this study, the researcher has also presented complete details of the research process or audit trail to ensure dependability.

3.7.5 Confirmability

According to Shenton (2016), the concept of confirmability is the extent to which the researcher doesn't interfere with the findings of the study, it may be through judgement and impartiality. Confirmability advocates the conclusions that purely present the results of the study, as the ideas and experience of the partakers. The survey should not present the ideas and ambitions of the investigator. In this study, the researcher applied the method of triangulation to eliminate the effect of personal biases, assumptions, perceptions and beliefs of the researcher.

3.8 LIMITATION OF THE STUDY

One of the limitations of this study is the small sample size. In this case, the findings cannot be generalised to another context. Instead, the findings are transferable to a context similar to where this study was conducted.

Furthermore, the study relied on self-reports collected through semi-structured interviews. The use of secondary data would have been insightful to understand the process and checklists of what aspects of green building the professional engineers focus on in choosing space for government occupation. To rank the factor in terms of level of significance in influencing the decision to release the results or not, it would be helpful.

3.9 ETHICAL CONSIDERATIONS

Researcher adhered to appropriate moral principles and ethical standards during the process of conducting research. To ensure that proper ethical principles are adhered to, the researcher obtained an ethical clearance certificate from the UKZN research office ethics committee before research survey commenced (Ethics clearance number: HSS/0401/016D). The gatekeeper's letter obtained from the KwaZulu Natal Department of Public Works as the participating institution for this study. Participants consent was sought before data collection. As part of ensuring informed consent and voluntary participation, the purpose of the research was explained to participants.

Furthermore, the respondents were all made aware that participation was voluntary, and they could withdraw anytime from the study when it warrants them to do so. Participants identity was kept anonymous, and the information they provided was treated as confidential and was strictly used for academic purposes only. All sources used in the study acknowledged through citations and bibliography. The Objective reporting of findings is provided. Turnitin was used as a method to monitor plagiarism, and the accepted similarity index by the school observed.

3.10 CHAPTER SUMMARY

This chapter explained the research process and methodology used in this particular study. The process was elucidated and expounded on, from the research methods used which is a qualitative study to be used for data collection methods (questionnaire schedule), sampling approach followed (purposive sampling) and data analysis methods and system (Thematic analysis). Methods applied to ensure validity and reliability were also explained and lastly how the ethical issues considered.

CHAPTER 4: PRESENTATION OF THE RESULTS

4.1 INTRODUCTION

In this chapter, the researcher presented the findings of this study. The main objective of this study was to explore how professional engineers consider green building strategy in choosing space for government use. In this regard, the study indicates that professional engineers had a variety of features considered to choose space for government use. In presenting the results, the first themes will be what is considered in determining space for the government to use by a professional engineer, then followed by themes reflecting capabilities required by professional engineers. Lastly, the chapter presents findings on recommended strategies to implement GB within the public sector.

4.2 WHAT IS CONSIDERED BY PROFESSIONAL ENGINEERS WHEN CHOOSING SPACE FOR GOVERNMENT USE?

The findings of this study show that professional engineers at the DPW consider five key issues when choosing office space for government use. These include: 1) enhancing energy saving and efficiency 2) promoting saving on consumption of operational costs, 3) Internal comfort of the users of the building, 4) enhancing water saving and efficiency, and 5) accessibility of the building to the public. These themes are presented in details in table 4.1 below.

Table 4.1: Themes on what considered when choosing space for government use

Focus of themes	Frequency
Enhancing energy saving and efficiency	8
Promoting saving on consumption of operational costs	7
Internal Comfort of the users of the building	6
Enhancing water saving and efficiency	4
Accessibility of the building to the public	3

4.2.1 Enhancing energy saving and efficiency

A total of 9 professional engineers indicated that enhancing energy saving and efficiency as one of the key aspects they consider in looking for space for government use within the province of KZN. The respondents expressed resource efficiency as making use of least amount of energies such as power, air conditioners and lights and also seeking alternative sources of energy- such as wind power and solar power. Additionally, below is what one of the engineers had to say when reflecting on what is considered in choosing space for government use:

For green buildings, we consider resource efficiency. So, saving energy and using the least amounts of energy, using the least amounts of water and then trying to reduce waste going to land. So those are the three main focuses when we are looking for office space for the government. It is just resource efficiency. After that, once we have achieved resource efficiency, then we look at alternative energy sources like solar power, wind power and alternative water sources as well. (E2).

One of the participants highlighted that she looks at the nature of the building to be outsourced to the way the options of the ventilation system that will be appropriate to save energy. In her own words, she mentioned:

It is my responsibility to look at mechanical engineering reports. It will not look at electrical engineers or the architects. And, commenting on the concept reports talking to mechanical systems, which is the air conditioning and ventilation, as well as the amount of energy consumption will be utilized, as well as medical gas and fire. Nevertheless, the biggest one is probably looking at the air conditioning system in terms of its sustainability. (E5).

Another aspect highlighted by one of the engineers was the position of the building, which he expressed his views as follows:

the orientation of the structure determines whether it was going to get a lot of solar heat gain or loss. The reason why this is important is that a poorly positioned building is corrected by excessive electricity demand in heating and cooling (E3).

4.2.2 Promote saving on consumption of operational costs

A total of seven professional engineers pointed out that it is vital that in the process of sourcing the space for government use the professional engineers also considers the issues of minimizing the operating costs to save the budget. One of the respondents has this to say:

To achieve cost savings so that the public money can go a bit further. Retrofitting the office building helps in the aspect that a green building is usually slightly lower in maintenance costs. Furthermore, in that way, maybe it is a 2% to 3% extra capital cost, and that would be recovered within the first 5 to 10 years of the operational cycle. We did two projects, which are Department of Public Works - Ixopo district office, Department of Education in Port Shepstone, and there is a head office building for Public Works in Pietermaritzburg. So that already makes three office buildings. We are also busy with the Arts and Culture building, but that is a retrofitting again. There are some green building planning principles we added to reduce on the heat gain, and it is general repairs and renovation upgrade (E7).

It is notable, some of the delays in having the green building considered when choosing space for government is the fact that there is a negative notion that the strategy is expensive and other clients department are reluctant to embrace the concept. One of the professional engineers highlighted this:

During the technical process flow, a checklist on green building is discussed to encourage and stimulate the debate on green building to a client's department. There is a perception of believing that Green Building is expensive. However, the study done by the council of quantity surveyors presented that the green buildings are only 5% more than the conventional structures. The saving on consumption on operational costs they have not done which the study pending. We want the high quality of the product that will be cheaper on maintenance costs, and we want to be leading in the industry, we do not want to be left behind. (E10).

One of the veteran professional engineers depicted his point of view that is slightly different when it comes to green building strategy. The professional engineer highlighted that:

if the building is to be registered with the Green Building Council of South Africa and target a rating and to achieve all that it may find that specific points would be more expensive to achieve. In contrast, other points are the low hanging fruit points that are cheap or do not even have the price tag. There is still quite a big price tag to achieving a green star rating in this country, although some might argue that it is not. Nevertheless, if things can be done creatively with a very talented and collaborative professional team, they can keep their maintenance costs

down. It needs to be an integrated design. It is not a matter of greenwashing all sorts of expensive technology onto the building before, and it is not just about that. It is to start with first principles. It is about designing a building that requires as little electricity and water (E9).

4.2.3 Internal Comfort of the users of the building

During the process of considering the space for government use, six of professional engineers stated that the buildings renovated to be friendly to the environment and the tenants. The building should bring comfort to the tenants, and it should at least fulfil the humanistic needs in relations to the benefits such as high energy performance, human comfort, indoor environmental quality, less greenhouse gas emission and high workplace productivity. One of the experienced professional engineers expressed that the:

DPW to introduce environmental sustainability strategy. If the building orientated correctly, it perpetuates sustainability. People had natural light when the building positioned correctly. It becomes a space that has a shallow carbon footprint, a space that does not pose on its environment negatively and is the sort of space that is healthy and happy for people to occupy. Somehow, the appointed consultants shy away to introduce the aspects of green building in full when designing the plans (E10).

Additionally, the position of the building contributes to the natural light that the users may experience while at work. The direction of the walls, the structure of the building affects the type of ventilation used has effects on the quality of cooling and heating atmosphere created for the occupiers;

We look at the proposed design of the features for the precinct, and it should be able to block the heat during summer to minimize the use of the ventilation. Then in winter to retain the heat in the building to minimize the utilization of the ventilation (E2).

4.2.4 Enhance water saving and efficiency

During the process of considering the space for government use, four of professional engineers mentioned that the building to be friendly to the environment, the rainwater harvesting tanks installed to supplement the natural system;

We look at rainwater harvesting, boreholes as well. So, we just tried to focus on resource efficiency to make sure we do not use too much water, we do not use too much electricity and not generate too much waste (E2).

One of the participants highlighted that he also looks at the solid structure of the building to way the options of the ventilation system that will effectively save the water.

Nevertheless, when providing the air conditioning, what is the most efficient way we can provide air conditioning? Then, the next thing to check is, can we provide the air conditioning that does not have a substantial water footprint? Because some systems are cumbersome on water and the critical interest is the light consumption of water, so its better try to stick to the concepts, the air-con concepts that are not heavy on water (E5).

One mechanical engineer indicated that:

In terms of environment, the ventilation system considered it should contribute fewer carbon emissions, that is the main thing. And then in terms of water efficiency, basically less the number of natural resources, water which is a natural resource. And then the third one is choosing sustainable refrigeration, which will reduce damage on the ozone layer, So, less dense on water and less damaging(E1).

4.2.5 Accessibility of the building to the public

Three of the Interviewee's highlighted that in terms of the government immovable assets management act, they ought to ensure that the government buildings are closer to the public transport, for ease of access to the civilians.

During the office accommodation process, it is vital for the building to be closer to the taxi ranks, or to be in the town where it can be accessed easily to the public. So, this is according to the GIAMA, which is the act that guides the department (E2).

Another interviewee said:

One more thing that is important is the location of the building, easy access to the community that the department serves is paramount (E10).

4.3 CAPABILITIES OF PROFESSIONAL ENGINEERS NECESSARY TO IMPLEMENT GREEN BUILDING.

The study reveals two sets of capabilities which professional engineers have and do not have to implement green building strategy. The results of this study, show that professional engineers have the ability to assess the usage of energy efficiently, ability to evaluate the usage of water efficiently, and ability to analyse features of green indoor environmental quality.

Table 4.2 depicts the variety of themes on capabilities that the professional engineers have and the capabilities that the professional engineers do not have to implement the green building strategy in KZN.

Table 4.2: Themes on capabilities that the professional engineers have and the capabilities that the professional engineers do not have.

Focus of themes	Frequency
Capabilities that the professional engineers have	
Ability to assess the usage of energy efficiently	8
Ability to assess the usage of water efficiently	5
Analyzing features of green indoor environmental quality	4
Capabilities that the professional engineers do not have	
A systemic approach to look at GB as a response to climate change	3
Ability to educate client's from other departments on GB.	7
Ability to Monitor and Evaluate the Green Building performance	4
A clear understanding of financial implications and practices in a green building space	3
Green leasing skills	2
Expertise to develop green buildings regulatorily	7
Ability to implement change	3

4.3.1 Ability to assess the usage of energy

Most of the engineers expressed their views that the assessment on consumption of electricity in the building is critical competency required; this is the part that minimises the maintenance costs of the building. The motion sensors lights, low light energy LED globes, and natural lights are the features that need to be installed in the building to improve resource efficiency.

The first thing is to acquire the building that consumes less energy to run by installing the motion sensors, hydro-boil with time, low energy LED light globes, backup generator. To have the solar geyser installed that will assist with energy efficiency, and the billing costs from the

municipality will drop significantly. These will be expedited by skilled and experienced professional engineers (E9).

Accordingly, a substantial decrease in maintenance and operational costs will be influenced by the usage of resources efficiently. The engineers with the know-how and skills are critical. One participant mentioned that:

As a person with technical expertise can influence the decision on the selection of the type of conventional air-conditions and natural ventilation to be installed. The lesser the demand on the power grid, the better. Because at the moment, our only source of power, is supplied by Eskom and it is coal-driven (E7).

4.3.2 Ability to assess the usage of water efficiently

A notable number of interviewees indicated that another most important feature considered when outsourcing the space for the government to use is water. The professional engineers also explore the provision of water to the building and exploring other alternative avenues to the source of water. The competency of assessing water usage is the critical competency required to be exhibited during the process of outsourcing space by the professional engineer. Options of water harvesting tanks are the features considered for the building to improve resource efficiency.

One of the participants indicated that:

The features such as water harvesting tanks, aerators tap, low capacity toilet cistern are a vital part of the building to preserve the usage of water. Digging a borehole is highly considered in the areas in the province where they are affected by drought (E4).

Another interviewee mentioned that as a mechanical engineer, during the checklist process, she focuses more on ensuring that the ventilation system to be considered it is not oppressive on water consumption. And also, the rainwater to be used for flushing toilets, especially in the areas where water is a scarce resource. In her own words, she said:

During the assessment, I do not compromise on the energy efficiency aspects such as mechanical systems, such as air conditioning and ventilation, the water supply and reticulation, and lastly, medical gas and fire. However, the biggest one probably is the air conditioning system in terms of sustainability. It is important to scrutinize and check if it is heavy on water footprint? Because you can get a system that is very heavy on water and our

interest is more on water preservation, so always try to stick to the concepts, the air-con concepts that are not heavy on water (E3).

4.3.3 Analyzing features of green indoor environmental air quality

The study also exposed that some of the interviewees expressed their concern on the existing old stock that other client departments currently occupy. These buildings pose a risk to the well-being of the tenants, due to damp and mould perpetuated the old structure. It creates the poor indoor air quality that gets to be inhaled by the tenants. The sentiments echoed by one of the interviewees.

Retrofitting the existing old stock will lower the risk of damp and mould to the health of the staff. These buildings do not have the appropriate ventilation or even natural air, and some windows do not open anymore, they inhabitable to be frank. The appropriate ventilation system to achieve energy efficiency and health priorities for efficient indoor air management is essential (E7).

One of the benefits offered by green buildings; it has the quality of air for employees and their performance on productivity increases.

It is claimed that employee's performance and productivity decrease with inadequate ventilation system provided by the employer and also when there is a provision of outdoor natural air the likelihood of performance increase is high (E5).

4.3.4 Systemic approach to look at GB as a response to climate

According to a notable number of respondents explicitly mentioned that the department had not done much to encourage and provide educational training advocating the green building to client departments as the strategy to mitigate climate change. The interviewees indicated that there is no buy-in by other client departments, and this has created the resistance for the implementation of the GB and no green building policy approved in this regard to expedite the implementation. One participant stated that:

...there's so much more that we can take the initiative in doing as the line department even internally, there is very little that we know about green buildings and sustainable development. Public Works is not doing much of the awareness to equip and capacitate the staff with knowledge of GB as a response to climate change (E5).

Another respondent concurred with the previous participant and stated that:

There is a need for an integrated approach to be taken by the department to create awareness and provide information that will be enlightened and equip the professional engineers with knowledge. Moreover, some educational training that will bring awareness needs to be conducted within the department and its user clients. The green building training program offered by GBCSA will be additional training. (E4).

One of the participants who are long-serving professional engineer in the department highlighted awareness is required to capacitate staff to unlearn some of the embedded behavioural patterns that are not in favour of a sustainable environment. She said in her own words:

We enrolled the retrofitting program on the old conventional building at head office, which embedded features of GB. And then we also try to create awareness of the people within the buildings through emails. Awareness of what is going on around in the world and awareness the department aimed to achieve in the building. So, if we create awareness on resource efficiency, people will change their behaviour, switch off lights, be more conscious of using too much water and too much energy. We try to drive that awareness and make sure they understand the stuff that we are implementing, all the initiatives that we are implementing so they also can appreciate the environment (E3).

Another participant stated that green buildings are usually not seen as matter of vital importance, especially in public institutions and organisations by the executives. He stated that:

We think some of the challenges are just the lack of knowledge, and there is ignorance at a high management level of the department. At one of the conferences our chief director was saying, in the next conference, we have to take along our finance director, and other directors in strategic positions because they do not know any better. Furthermore, there are also lots of perceptions around green buildings that are incorrect and the limit of knowledge, linked with wrong perceptions that green buildings are expensive which leaves with these people in high positions that cannot make informed decisions (E2).

4.3.5 Ability to educate the client's from other departments on GB.

Notably, five of the participants highlighted the need for the educational training required to all the executives, management and staff in the province of KwaZulu-Natal. The professional engineers to take the lead and enrol the education programme to address the negative perception and resistance associated with green building. One of the professional engineers strongly believe that the integrated approach is required to implement the GB strategy successfully and effectively; this is her own words:

The notion of GB being expensive may not be accurate. If the GB project looked at holistically, it might be expensive to build at the initial stage. However, it is cheaper in the long run to maintain the building. Therefore, awareness through information sessions and training is critical to all stakeholders, and an integrated approach is essential (E3).

Another professional engineer highlighted that some client's department perform their procurement of office accommodation due to lack of confidence to the processes of DPW. Conducting educational training in the form of information sessions and workshops may strengthen the relationships, encourage the client departments to embrace GB, and it will eliminate working in silos. Participants mentioned that:

The various client's department has various infrastructure directorate. An integrated approach is essential to achieve the goal of efficient infrastructure delivery. DPW is not the only Implementing Agent that the user department has; they have other implementing agencies in the market. Sometimes the user department only focuses on delivery time frames and price rather than product quality to be delivered. The quality of the product delivered is it sustainable in the future? The inferior quality of product delivered in the future would be costly to the government. Therefore the educational training would create an opportunity to form an integrated systematic approach (E5).

4.3.6 Ability to Monitor and Evaluate the Green Building performance

Some of the current prevailing piece of government legislations pose a challenge when it comes to assessing the performance of GB operational costs and impact of the conventional buildings on the environment. The department is alleged not to have the audited list of immovable assets stock, which may hinder the assessment on the performance of the overall stock. One of the interviewees commented as such:

The existing regulations in government prohibit the work to be outsourced for more than five years, this complicates the monitoring of building performance as they get monitored over much more extended periods, and the data is compromised if more than one company monitors building performance. In case we do retrofit for greening the building, we need to ascertain how effective the retro-fitting is. (E9).

Another interview participant added his views as follows:

The department must put its effort to conduct audits of existing buildings, the asset registers of our buildings are not on records, do we even know what buildings we have? Secondly, do we know what our buildings have in them? What equipment? What equipment assets do we have? Thirdly, do we even know how they perform?. There is no enough knowledge about the departmental assets before we even know how they are performing (E2).

Another interviewee advocate that a holistic approach is required to assess GB performance, the notion of labelling it as expensive is not factual, and this is his own words:

There is no full assess on operational costs benefit that comes with GB strategy. The user department only focuses on initial capital spend on the inception of the project due to the lack of competencies amongst the engineers. Life cycle costing is not considered holistically (E6).

Additionally, one more participant concurred with the sentiments above:

What we should also do is to have Accounting systems to be operated by skilled technical staff who will monitor meters, water meters and electricity meters to see what the saving is. Sometimes the municipal system is likely to be accurate, or they use estimates in-between, and the Auditor General assess the accuracy of these performance reports (E1).

The researcher is of the view that the professional engineers are not adequately competent to successfully implement green building strategy within the department and to client departments. The green culture is not eminent in the organization, even thou some of the buildings graded as green through retrofitting. There are minimal efforts on advocacy and awareness on basic knowledge of green building by the department. There is no monitoring tool in place to assess the operational performance of existing immovable assets stock, perhaps is because of none availability of the assets register of the department as indicated by one of the interviewees.

4.3.7 Clear understanding of financial implications and practices in a green building space.

Most of the engineers expressed the view that there is a perception that green building will increase the financial demands on constrained budget allocation received by the department and client departments. Finance and procurement people robbed in to support the professional engineers may assist in addressing the reluctance and resistance to implementing green building by client departments through their involvement in the processes. One participant mentioned that:

As a person with technical expertise, the influence on the technicalities of the green buildings is inevitable. So, if someone from finance and procurement, first of all, they might not understand the technicality, but then they would be in a position to influence the decision on budget allocation and estimates on the maintenance costs and we also require to write the specifications and criteria for success of the project. So, people within procurement with an understanding of green building will assist the process to go smoother (E4).

Another participant stated that green practices are usually not seen as matters of vital importance, lack of knowledge and understanding about the green buildings practises by the executives provide a lack of leadership to advocate the culture of green building practice to all employees. The statement was supported as follows:

Some of the challenges are just a lack of knowledge, and there is ignorance at a high management level of the department. At one of the conferences our chief director was saying, in the next conference, we have got to take along our finance director, and other directors in strategic positions because they do not know any better. Furthermore, there are also lots of perceptions around green buildings that are incorrect and the limited knowledge, linked with wrong perceptions that green buildings are expensive which leaves with these people in high positions that cannot make informed decisions (E2).

Another interviewee advocates that holistic approach is required to assess GB, the notion of labelling it as expensive is not factual, and the conventional buildings are more expensive to maintain throughout their life cycle, this is his own words:

A change management drive required for transformation and continuous changes posed in by climate change across the globe. There is no full assessment on operational costs benefit that comes with GB strategy. The user department only focuses on initial capital spend on the inception of the project. Life cycle costing is not considered holistically. The conventional

building it is too costly to convert it. The buildings become more expensive to be maintained in the future (E6).

4.3.8 Green leasing skills

The department of Public Works outsources office accommodation on behalf of other client departments, wherein the lease agreements concluded between the DPW and the landlords. There is a need to have the competencies within the organization to be able to administer the green leases for all the leased green buildings. One of the participants mentioned that there is a lack of skills within real estate management division to manage the administration of green leases in this regard.

Then we also need someone in leasing, for green leasing because we lease quite a considerable number of buildings (E2).

4.3.10 Expertise to develop green buildings regulatorily

The respondents revealed that there is no GB policy framework approved in the department. Some level of compliance can only be applied when there are existing policies in place. The expertise of developing legislative frameworks to guide the work-plan of professional engineers is crucial. Seven respondents indicated that the policy has been on a draft stage for almost half a year. One of the participants mentioned that:

There is a draft policy in place for the KZN Department of Public Works. The policy was supposed to be presented to cabinet in October last year, but because of the elections, it was put on hold. We drew up our own from National's policy of DPW. Once we have the policy, we will be able to enforce it on all the other client departments without any questions, but until then, we have to sit and wait (E10).

Other participant was in concurrence and added his reasons as follows:

The ability to facilitate the prompt approval of Green building policy, trained professionals within GB to enrol the policy are a necessity. All infrastructure project to have 30% aspects of GB, Awareness is critical to the whole province for effectively implement the GB strategy (E8).

Alignment of all the prevailing legislative regulations is fundamental to minimize the confusion and also on the same token advance the green building practices.

Engineers to be made aware of the aspects of the green building regulatory policies that they will need to comply with concerning climate change. It is, however, critical to align all these pieces of legislation. PFMA is one policy aims to guide the management of finances and SANS10400 is a regulation that is in support of the architect and is energy efficient, each discipline has its own regulations that have the element of Green Building. The electrical engineers will have instructions on the light settings, motion sensors and sunlight. The structural engineers will be on the water usage, sewer system and mechanical will have the instruction on hydro-boil, air conditioners. SANS compliant is critical even to the Implementing Agent.

4.3.9 Ability to implement change

The participants expressed their views in relations to the lack of change management in the public sector. Very few executives are flexible to change and portray the traits of being transformational leaders and take charge of being the change agents. The participants indicated that it takes a very long time for the government to implement the GB effectively and to advocate for the measures to mitigate climate change, in many instances the management reacts to the situations rather than being proactive.

Change management as a virtue is required, the executives and seniors to adopt the strategies that mitigate the effects of climate change in their respective organizations. Government to invest in educational training, research and development towards a green economy (E9).

Another interviewee added as follows:

Pick up the opportunities that come with the green building to contribute significantly to the value chain. The leadership is required to push the change management. The government can take about 30 years to implement the new strategy successfully; change management requires a business model that will be unique to the public sector (E7).

Some of the old staff are reluctant to embrace the new legislation on green buildings and adapt to the new way of doing things, this exposed by one of the interviewees, and this is his own words:

We are also trying to review the standards and norms that were set for years, and there is a lot of older professional engineers here, so to change them, from what they have practically been doing their entire life is quite tricky (E4).

4.4 RECOMMENDED STRATEGIES TO IMPLEMENT GB WITHIN THE PUBLIC SECTOR.

In this study, professional engineers revealed four key recommendations to implement GB in the public sector in KZN. The four recommendations include 1) Integrated approach to enhance green economy 2) Conducting educational training and awareness to all clients departments 3) supportive organizational structure for GB activities and 4) the building of green technical capabilities of professional engineers in public sector. The themes depicting the recommendations relevant to implement GB within the public sectors are presented in table 4.3 below:

Table 4.3: Themes on recommended strategies on GB within the public sector

Focus of themes	Frequency
An integrated approach to enhance the green economy	4
Conducting educational training and awareness to all clients departments	3
Supportive organizational Structure GB activities	4
Building the green technical capabilities of professional engineers in the public sector	7

4.4.1 Integrated approach to enhance the green economy

The interconnectedness approach should consider enhancing the discussions addressing the matters about the green economy in the province by all government departments. The green economy will assist the public sector in engaging in economic activities that will results in improved human well-being over the long term, protecting ecological scarcities and not negatively impact the environment in pursuit of the economic growth. The statement was concurred to as follows:

We need a system approach of which each department, provincial, local and national sphere of government has GB approach with objectives. The municipality can contribute probably by creating energy efficiency technology, the department of economic development can encourage the development of the green economy. Infrastructure projects should at least allocate 50% to GB, this principle to be implemented by all spheres of government (E6).

Green building is one of the strategies to be used by professional engineers to mitigate climate change. An integrated approach will assist with awareness to understand the benefits of the green economy. One of the interviewees mentioned that:

We should be able to bring all other departments into confidence that we are championing to build a green economy. In doing so, they will understand that they are building a green economy, that will create green jobs, protecting the environment and creating green entities (E8).

Government is the biggest supplier, and it can consider using its buying power to enforce compliance of a green economy with the suppliers intending to do business with the state. The participant echoed these sentiments:

We need to first start by greening all the existing buildings/infrastructure, retrofitting all of them so that we can promote resource efficiency. From a business point of view, the government can start forcing business to say we will only deal with companies complying with the practice of going green (E1).

4.4.2 Conducting educational training and awareness to all clients departments

The professional engineers responsible for choosing space for government use has a more significant influence to educate and provide relevant information in relations to green buildings across the public sector in the province.

We think it is awareness, and most people are not aware even those with awareness have limited understanding and target the executives who are the directors, deputy director generals and head of departments because they are the ones that sign off the strategies and if you limit the resistance from them it will be better (E3)

Additionally, intensive rollout educational training, workshops and information sessions on GB requires a coordinated approach involving all client's department. The state to also consider investing in research and development towards green building.

Intensive educational training will assist client departments made aware of GB since we are in 4th Industrial revolution people and technology change. Having to implement GB will assist the government to be better (E7).

4.4.3 Supportive organizational Structure to GB activities

Implementation of strategies do not take place against a characterless background but must take account of the structures of the organization in which they will implement. All three-sphere is of government in the province to establish the component within their respective organization to support the green building.

We do not have full staff complement structure and unit of Green building within DPW which is a challenge to implement the aspects fully, we entirely rely on the consultant. The integrated system is required between the local, provincial and national sphere of government to establish the units within all departments to support the lack of skills and capacity required to support green building initiatives (E7) fully.

Organizational structures determine what actions are feasible and most optimal, considering the capacity and resources that the organization possess. A notable number of interviewees expressed that the department and province must address the gap of skills and competencies.

We need technical resources in terms of certified green building specialists and verification consultants, certified energy auditors, water and energy auditors. Someone in leasing, for green leasing because we lease quite a few buildings. We need a budget as well to establish the structure/organogram that will focus on green building initiatives across the public sector (E2).

4.4.4 Building the green technical capabilities of professional engineers in the public sector

The organization needs to have sufficient staff complement, equipped with the right skills and competencies. Most professional engineers indicated that educational training is required to equip the existing professionals on green building competency compliance and green economy.

We have an issue of competency and lack of relevant skills as yet within the province, that is from municipalities level upwards to implement the green buildings. It requires knowledgeable personnel, it takes years of experience, to be able to apply the policies (E5).

4.5 CHAPTER SUMMARY

In this chapter, meaningful results from the interviews are contextualised within the objectives of the study presented. The findings reflected how professional engineers at the DPW consider the green building as a strategy for choosing space for government use, enhance energy saving and efficiency; promote saving on consumption of operational costs; Internal comfort of the users of the building; enhance water saving and efficiency and the accessibility of the building to the public. The study revealed capabilities that the professional engineers have and capabilities that the professional engineers do not have to implement GB strategy effectively. The professional engineers have capabilities such as the ability to assess the usage of energy efficiently; ability to assess the usage of water efficiently and analysing features of green indoor environmental quality. The capabilities required by professional engineers are presented as a systemic approach to look at GB strategy in response to climate change; tail by the ability to educate other client's department on GB; ability to monitor and evaluate the green building performance; clear understanding of financial implications and practices in a green building space; green leasing skills; expertise to develop green buildings regulatory and ability to implement change.

Lastly, the findings predict the strategy to implement the GB within the public sector and the integrated approach to enhance green economy, conducting educational training and awareness to all client departments, supportive organizational structure on GB activities and building the green technical capabilities of professional engineers in public sector. The next chapter will present the report findings and discussions of the results.

CHAPTER 5: DISCUSSION OF FINDINGS

5.1 INTRODUCTION

This chapter aims to discuss key findings of this study which reflect on green building as a strategy to mitigate climate change at the Department of Public works in KZN. These findings discussed with existing literature and studies relating to green building and the capabilities required by professional services.

5.2 SUMMARY OF FINDINGS

The results categorized according to each of the objectives of this study. Firstly, it is noteworthy that one of the significant findings of this study with prominence on how professional engineers in the Department of Public Works in KZN consider green building strategy in choosing space for government use was with the majority of respondents. Most professional engineers emphasize the critical aspect as enhancing energy saving and efficiency to minimize the adverse impacts that the buildings can potentially bring to the natural environment and reducing the building operational costs. In recent times the sustainable workspaces are becoming more prominent, and some may even argue that a more energy-efficient building correlates to a more efficient and productive work environment, this is the argument presented by (Cabeza, Rincón, Vilariño, Pérez, Castell and reviews, 2014). The finding is in agreement with the study conducted by Nguyen et al. (2017) they mentioned that sustainable use of energy resource is where the shortage of energy supply predict the negative impact on the environment and that of climate change is creating the urgent need for collective effort to endeavor to keep the use of sustainable resources as low as possible. This research study discovered that professional engineers demonstrated green technical capabilities during the process of choosing space for government use. The elements such as enhance energy saving and water efficiency were determining factors used. The effort is acknowledged, and it portrays some level of competency in executing their work. There is level of awareness and willingness to embrace green building to mitigate the effects of climate change, this could be a positive sign towards the aspirations of greening the department.

According to Zhao et al. (2017), climate change in its nature expand the utilization and consumption of energy in office buildings; these happen during the cold and hot climate seasons. Generally, the consumption of electricity in summer would be higher in office buildings due to the usage of a cold ventilation system, and this adds pressure to the overall

energy suppliers. Notably, the office buildings perceived to be the highest types of buildings that are high in consumption of energy as compared to other types of buildings (McLaughlin and Nichols, 1994). So, professional engineers must advance and explore different strategies that will assist in decreasing even further energy consumption in office buildings. This can be applied by using renewable energy sources such as solar energy, wind energy and other sources which contribute to rechargeable energy rationalization (Wilkinson, 2012). It is suggested that the adaptation of Green Buildings simulate the benefits of minor consumption on energy and envelope excellent performance during the winter and hot season climate, where there is an expected pressure on the usage of ventilation system (Son and Kim, 2015). This evidence is consistent with the previous study conducted in Europe that states building industry experts have begun to pay attention to controlling and correcting the environmental damage due to activities. The architects, engineers, designers, and project managers to name the few who are involved in choosing office space for government use have a significant role to play in reducing environmental impact through implementing sustainable development goals (Akadiri, Chinyio and Olomolaiye, 2012).

Accordingly, it was proposed that the professional engineers must endeavour to consistently identify the business operations that can further bring reduction on overall energy usage at the facility level by encouraging green practice behavioural patterns to staff members. Additionally, managing the energy consumption associated with specific production processes and supporting utilities, which would result in costs saving. The professional engineers may also consider the use of modern energy management systems to monitor the efficiency on energy usage optimally and to be able to conduct a precise cost-benefit analysis to determine if they are costs saving or not on the maintenance of the building.

Secondly, building the green technical capabilities of professional engineers in the public sector is the finding that most participants determined that it is necessary and required by professional engineers to implement green building effectively. It is the green technical capabilities that most professional engineers felt strongly that is required, there is a lack of support and provision of continuous adequate educational training provided in order to increase the green technical capacity and competency. A minimal number of professional engineers are knowledgeable with the concept of GB, as it is a relatively new concept in the market. The professional engineering mentioned that the skills and competencies required in the area of certified green building specialists and verification consultants, certified energy auditors, water and energy auditors and green leasing consultants to fully display the expertise in executing

the green building practices in the public sector. Johnson et al. (2008) cited that the capabilities recapitulate what the organization is busy doing at this point and what it is the strategic direction it needs to undertake in order to meet current future challenges. Technical skills in the green building include energy systems, ventilation, natural light use, water use, waste reduction, pollution prevention and low environmental impact techniques. The professional engineers currently they are more skilled in energy efficiency systems, which focuses more on the consumption of energy attributed by the buildings. The focus areas of the professional engineers when choosing space involve features such as heating and cooling ventilation, LED lighting lights, motion sensors lights, hydro-boil with timer. And building energy simulation but not optimally consider the techniques with new technologies such as natural ventilation methods, familiarizing with green building rating tools and solar heating. It concurred with the study conducted in Thailand, Shen, Tang, Siripanan, Lei, Duffield and Hui (2018) mentioned that GB requires green technical capabilities that would contribute to the improvement of sustainable building performance. Even so, that does not automatically mean that the existing engineers and architecture have the corresponding capabilities to apply the green building practices successfully.

It is now essential that all the professional engineers, the old and the new get to be capacitated through continuous educational training to close the shortage of green skills gap, this will eliminate any issues of deficiency on delivery of green agenda programmes. The external environmental forces propel the department to revise its business model to deal with the threats and opportunities that prevail due to changing environments. The statement is in agreement with the thoughts of Teece (2018), who argues that the resources and capabilities that are just adequate for business operations are unlikely to keep the organization sustainable in the market. The empirical study conducted in China, by Li and Liu (2014) explored – “*Dynamic capabilities, environmental dynamism, and competitive advantage: Evidence from China*” It indicates that in the context of Chinese, as emerging markets, the firms applied dynamic capability to systematically solve problems, formed by the inclination to sense opportunities and threats in the market, make and implement sensible strategic decisions, and changes efficiently to ensure the right direction.

Construction building practitioners globally, they are now beginning to embrace sustainability, and this makes the industry to reproduce. Competency, expertise and the skills of the staff are the engine and greatest assets and gives any organization a competitive advantage to sustain the business. Therefore, the skills audit to be conducted to establish the gaps that may be in

existence for professional engineers in order to reduce the deficiency in the delivery of programmes (Hwang and Ng, 2013). Across the globe, the shortages of the relevant skills and competency to the energy-efficient buildings and technical designs for GB is a challenge. The built environment industry and government must create a platform that endeavours to close the gap through the skills development programmes to capacitate and equip the labour market (Ghaffarian Hoseini, 2013).

The findings demonstrated that for the professional engineers to have green technical skills, they should be competent in energy-efficiency techniques such as installing building energy simulation, heating and cooling ventilation. Furthermore, they should also consider combining these techniques with compatible use of solar heat. The professional engineers to also be skilled in using other ventilation methods which can assist in improving indoor air quality and reducing energy consumption by using technologies such as natural ventilation.

Thirdly, the expertise to develop green buildings regulations within the public sector is one strategy that the study revealed as the significant finding that most interviewees expressed. All participants revealed that there was no approved green GB policy in place, the policy has been in draft stage for some time. The professional engineers may be required empowered with expertise on how to drive the process of getting the policies and regulations of the GB approved by the relevant authorities. The lack of these competencies is the area of concern and requires urgent attention from the executives in the public sector. The regulations play a critical role, and they are a medium of instruction and the drivers that enforces change and consequence management to address non-compliance. In the absence of policies, the whole ambitions of green practice would be a fantasy. It will prove to be very difficult to instil change to the status quo and to push the institutions in a green path. The lack of policy direction creates a vacuum in giving the direction on how obligations executed, and it is a sign of poor administration that unsolicited the phenomenal of moving towards resource efficiency and greening the organization.

The sentiments supported by Howes, Wortley, Potts, Dedekorkut-Howes, Serrao-Neumann, Davidson, Smith and Nunn (2017) who indicated that around the globe, different governments committed to developing policies that will support the sustainable development. The array of new policies created to underpin sustainable development ranging from Paris international agreement, environmental laws, regional laws and national laws. However, despite these exertions, the scientists that monitor the impact indicated that there is a minimal

positive impact on environmental sustainability; instead, the situation is deteriorating. The sentiments also echoed in agreement by Cohen (2015) it is encouraging that most administrators and lawmakers around the world have already started to create policies and laws that mitigate the greenhouse gas emission and promote the use of sources on alternate technologies. However, with an effort to combat climate change, the cities need to speed up the process to keep the pace with rapid growth of population and acceleration on climate change.

The regulations and legislative framework are vital and critically important in the public sector as they provide the basis that creates frameworks in relations to all decision makings and establishing the standard operating procedures within the institutes. The outcomes of such findings should be of great concern to the executives, especially with ambitions to transmute the organization to a sustainable environment and resource-efficient. Sometimes there is a lack of commitment from the middle management to take fully the duties related to green practice, and they are viewed as additional responsibility rather than the green lifestyle to create sustainable organizations (Ramus and Steger, 2000).

The barriers and reluctance to accept the concept of GB can be caused by the fact that the current pieces of legislation create a bottleneck to implement GB strategy. Yu, Li, Yang and Wang (2015) mentioned that government narrates the barriers to implementation of the GB strategy to the lack of enforcement and inducements on the existing regulations. The economic factors are affecting the building industry that prioritise the economic profits over the sustainable softer values, the interpretation on technicalities, and lastly the institutional factors such as lack of capacity and skills.

Notably, the report according to International Finance Corporation online poll report, Nath et al. (2014) conducted by Asian Green Buildings Council concurs with the findings above and further mentioned that in Asia the following are:

- lack of Green Funding - 23,6%
- lack of market awareness - 16,7%
- Resource and Skill Gap - 5,6% and
- Others - 2,8%.

Howes et al. (2017) echoed the same sentiments and cited that the literature review suggests that the hindrances to achieving much anticipated positive outcome on environmental policies are depicted as lack of skills to develop relevant policies, political will, economic development, inability to communicate effectively to key stakeholders and government lack of incentives to support implementation of environmental policies.

It is against this backdrop that it suggested that the professional engineers be capacitated to develop the relevant green buildings regulations. They can also be able to create the operational plan that will advise on how the GB will be implemented and to invent monitoring tools to assist with the assessment of the effectiveness of the regulations. Moreover, to also be able to implement the GB regulations effectively. Needless to say, that the involvement of the executives will instrumentally show the commitment from leadership in support of the green building practices.

Lastly, A notable number of the respondents expressed that conducting educational training and awareness to all client's departments by the professional engineers, through advocating and educating the employees, client departments and stakeholders in public sector on GB practices. The professional engineers are responsible for deciding on buildings to be outsourced for leasing to the state for office accommodation or any other government use. By this virtue, they strategically placed in a position of influence to take a role of being the agent of change by advocating for educational training programmes and awareness sessions to inculcates the green buildings and the benefits embedded to it.

Notably, the professional engineers knew very little about the green building's practices due to fewer awareness activities conducted internally by the organizations. Lack of understanding and some knowledge on Green Building results to resistance and ignorance to the application and implementation of the strategy from the client's departments and some professional engineers. The findings are supported by the study conducted at North America "*Making Environmental Employee Engagement Happen report which had a North American focus*", states that the organization should communicate its intentions to the employees concerning the plans around the environmental sustainability. The plan to include training and development of employees that will partake in those initiatives. The efforts can assist the employer to successfully implements the initiatives and improve performance on carrying out these greening programmes (Macey,Schneider,Barbera and Young, 2011).

The professional engineers have options of raising awareness through providing formal and informal education programs to all stakeholders. Internal communication methods such as intranets, notice boards, newsletters, and observe days such as conservative environmental day and world water day are the most common cost-effective methods. The other methods to be considered is organising formal workshops and training courses offered by GBCSA, wherein all the stakeholders and client departments within the public sector in the province can be invited. The Office of the Premier within the province of Kwa-Zulu Natal can be used as one amongst other methods of communication to pass through any GB legislative instructions and any other formal correspondence to all client departments in the province. The study conducted by Mtembu (2017) opined that providing any form of educational awareness in the area of greening and sustainable living to employees can significantly contribute to the accomplishment of achieving a green organisation. Management ought to play a significant role in driving the green philosophy through injection of the investments in areas such as creating a conducive environment, increase support structures and allocate the resources such as financial and human capital. Accordingly, the failure of an organization to execute its strategy successfully reflect on the calibre of executives that is in leadership (Sekaran and Bougie, 2016a).

Notably, the author further mentioned that the research and development of green buildings are still in its infancy, many green buildings are just pilot projects across the globe. In South Africa alone to date, they are approximately 200 buildings certified by the GBCSA they are in the private sector (Environment, 2009). It is against this background that the awareness on environment and energy issues intensified which will require the government to pay more attention. The research conducted by the scholars recognizes that the public attitudes and perception on green buildings may affect its acceptance and full application to the realization of the benefits embedded to the strategy (Zhao et al., 2015). Adopting green buildings prevails social obstacles as claimed by Zhao et al. (2015), such relates to general public behaviour and attitudes that may be out of ignorance, the primary client understanding and awareness, purchase intention, the prevailing humanistic needs, and the rebound effects. Zhao et al. (2015) further mentioned that despite the highlighted social obstacles in the background, there is potential social acceptance of GB, if more awareness on benefits of green buildings about the wellbeing of people contributed by biophilia system integrated in the design and positive impact on environment, the sense of apathetic disappear, and people are willing to pay more over the traditional buildings.

Findings exposed that while most government departments were well keen to implement GB strategy to mitigate climate change, some were not able to put it into practice due to lack of competency, skills and knowledge. Top leadership in the province to be equipped with knowledge and confidence to be able to inspire all the workforce in their respective departments. This will assist in making green building a societal matter wherein all employees commitment will be secured.

5.3 SUMMARY

In this chapter, the key results of the study were discussed in correlation with the objectives and questions of the research. The findings of this study deliberated in relations to literature to the themes such as to enhance energy saving and efficiency, building the green technical capabilities of professional engineers, the advocacy and education capabilities wherein the abilities to educate client departments explored. Similarly, the expertise to develop green buildings regulations by professional engineers at the Department of Public Works. The key findings of this study were also discussed and compared with the previous studies found within the frame of knowledge within the discipline of Green Buildings, wherein the consistencies and similarities considered. The next chapter will further review the main findings of the study, conclusions and recommendations.

CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

6.1 INTRODUCTION

The concluding chapter put layout summary of the main findings in relations to the objectives of the study, followed by recommendations ascending from the study and lastly the areas of focus for future research.

6.2 OVERVIEW OF THE STUDY AND SUMMARY OF FINDINGS

The main objective of this study was to investigate how professional engineers in the Department of Public Works in KZN consider the green building as a strategy in choosing space for government use. Another objective was to explore the capabilities of professional engineers that are key for the Department of Public Works to implement green building strategy in KZN effectively. Lastly, was to recommend the strategy for green buildings within the public sector in KZN.

The researcher applied a purposive sampling strategy for this study. The participants selected by the researcher based on their attributes, competency, knowledge and credibility about the subject of the green building as a strategy to mitigate climate change within the Department of Public Works in KZN. A total of 10 participants who are professional engineers from professional services division, within the Department of Public Works in KZN participated in individual semi-structured in-depth interviews. Data were collected using semi-structured and in-depth interviews with the selected professional engineers. Data was analyzed using thematic analysis to induce themes reflecting what professional engineers consider in selecting office space for government use, capabilities of professional engineers in choosing office space and recommendations for the implementation of green building strategy.

The results of the study reveal that professional engineers at the DPW consider enhancing of energy saving and efficiency, saving on consumption of operational costs, internal comfort of the users of the building, enhancing water saving and efficiency, and accessibility of the building to the public when considering green building and choosing space for government use.

Three capabilities which professional engineers actually have to implement green building strategy include the ability to assess the usage of energy efficiently, ability to assess the usage

of water efficiently, and ability to analyse features of green indoor environmental quality. However, the study has revealed that the implementation of green building strategy may not succeed as professional engineers in KZN. A lack of systemic approach to green building as a response to climate change, ability to monitor; and evaluate the green building performance and green leasing skills. In this study, professional engineers emphasized the importance of an integrated approach to enhance green building, educational training and awareness to all client's department, supportive organizational structure for green building activities and the building of green technical capabilities of professional engineers in public sector. It will ensure the implementation of green building as a strategy to mitigate climate in KZN. The findings have implications on strategy implementation and efforts to build the relevant capabilities of professional engineers to excel in green leasing for the government. If professional engineers do not have green technical capabilities and green leasing skills, it is implausible that they will implement green building as strategy for the climate in KZN.

6.3 RECOMMENDATIONS

The concluded findings in this study guide the recommendations depicted below.

6.3.1 Enhance energy saving and efficiency

The professional engineers to consider the use of modern energy management systems to monitor the efficiency on energy usage optimally and to be able to conduct a precise cost-benefit analysis to determine if they are reserves or not on the maintenance of the building.

6.3.2 Building the green technical capabilities of professional engineers

It is suggested that the professional engineers to possess the green technical capability, should not only be competent on energy-efficiency techniques such as installing building energy simulation, heating and cooling ventilation. Instead also consider to combine these techniques with compactible use of solar heating optimally. The professional engineers to also be skilled in using other ventilation methods which can assist in improving indoor air quality and reducing energy consumption by using technologies such as natural ventilation.

6.3.3 Expertise to develop Green Building regulations

It is suggested that the professional engineers capacitated to develop the relevant green buildings regulations, then they can also be able to develop the operational plan that will advise

on how the GB will be implemented and to invent monitoring tools that used to assess the effectiveness of the regulations. The involvement of the executives will instrumentally show the commitment from leadership will efficiently point the organization in the right direction of reaching the ambitions of greening the organization and public sector in KZN.

6.3.4 Build and enhance green building literacy among all client's departments in KZN

Green building literacy (GBL) is a term used to describe the hoped-for outcome of green building education which falls within the broader movement for public “built environment education”. Professional engineers must develop or craft green building education programs targeting not only government departments but also the leadership of government departments to change their mindset regarding the green building. A green building literate citizen or leader in a government department will benefit from foundational knowledge from environmental/sustainability education and science education to understand both the what and why of green building design and ultimately how to engage in transformative green buildings practices in government offices.

It is suggested that top leadership in the province to be equipped with knowledge and confidence through green building education to create green building literacy.

6.4 DIRECTIONS FOR FUTURE RESEARCH

The following are the areas for future research:

- There is a need for exploratory research to understand the green building literacy of professional engineers if they are to meaningful execute the green building policy of government in South Africa. This is vital to check if professional engineers have sufficient knowledge (factual, conceptual, and procedural) of green building and green leasing as a foundation for green building strategy implementation.
- As this study focused only on professional engineers who select office space for government, future research must get the views of government departments as the occupants of the green building if the green building strategy is to be implemented effectively in the public sector.
- As this study only used interviews to collect data, it is suggested that future research use mixed methods to quantify the green capabilities in terms of which one are more significant than others.

- Effective methods to rollout the awareness and teaching programmes on green practices, to all employees in the public sector.
- As this study has only focused on professional engineers in KZN, future research needs to be conducted in other provinces. With a bigger sample to establish a set of green technical capabilities to guide the training of professional engineers are key players in the implementation of the green building strategy in the public sector.

6.5 CONCLUSION OF THE STUDY

This qualitative study has investigated how professional engineers in the Department of Public Works in KZN consider the green building as a strategy in choosing space for government use. In selecting office space for government use, professional engineers from the Department of Public Works consider four issues, which are enhancing of energy saving and efficiency, saving on consumption of operational costs, internal comfort of the users of the building, enhancing water saving and efficiency, and accessibility of the building to the public. While the professional engineers have three capabilities of assessing the usage of energy efficiently, the usage of water efficiently, and ability to analyses features of green indoor environmental quality, they lack a systemic approach to green building as a response to climate change. Furthermore, they also lack the ability to monitor and evaluate the green building performance and green leasing skills, which are key to effectively implement green building as a strategy for mitigating climate change by the government. The findings of this study have implications on strategy implementation and efforts to build the relevant capabilities of professional engineers to excel in green leasing for the government.

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Appendix 1: Interview questionnaire

Initial Interview Guide

1. Consideration of green building as strategy in choosing space for government use.

- 1.1. According to you, what do you consider when choosing space for government?
- 1.2. Why do you focus on these factors, are they the only ones or you have more?
- 1.3. When do you consider these factors? Is it in specific case or all the time? Give me an example.
- 1.4. So, what aspects of Green Buildings do you consider or not?

2. Capabilities required for professional engineers

- 2.1. According to you, what are the capabilities for a professional engineer to implement a green building strategy? Give me an example of these capabilities helpful in implementing green buildings.
- 2.2. Kindly list these capabilities that can be of assistance in implementing the green buildings?

3. Recommend the strategy for green buildings within public sector in KZN.

- 3.1. According to you and your experience, what do you think is needed to effectively implement the strategy for green buildings within public sector in KZN?
- 3.2. According to you and your experience, what do you recommend as the strategy required to effectively implement the green building within public sector in KZN? Give me example.

Appendix 2: Consent letters

UNIVERSITY OF KWAZULU-NATAL
GRADUATE SCHOOL OF BUSINESS AND LEADERSHIP

MBA Research Project

Researcher: Ms M.A. Dladla - [REDACTED]

Supervisor: Dr M Kanyangale - 031 260 7934

Research Office: Ms P Ximba - 031-260 3587

Dear Respondent,

My name is Morwesi Annah Dladla, a final year MBA student at the University of KwaZulu Natal Graduate School of Business and Leadership. You are invited to participate in a research project titled Green buildings strategy to mitigate climate change: A case of Department of Public Works in KZN. The aim of this study is to conduct a basic research where knowledge will be generated to understand the green building as a strategy to mitigate the climate by the Department of Public Works in KZN.

Through your participation I hope to understand how the Department is implementing the green building strategy to mitigate climate change in KZN. The results from the focus group are intended to contribute towards learning and gaining insights into what capabilities that are key for the Department of Public Works to effectively implement green building strategy in KZN.

Your participation in this project is voluntary. You may refuse to participate or withdraw from the project at any time with no negative consequence. There will be no monetary gain from participating in this survey. Confidentiality and anonymity of records identifying you as a participant will be maintained by the Graduate School of Business and Leadership, UKZN.

If you have any questions or concerns about completing the questionnaire or about participating in this study, you may contact me or my supervisor at the numbers listed above.

The Interview should take you about 45 minutes to an hour to complete. I hope you will make yourself available for the interview to be conducted.

Yours Sincerely,

Investigator's signature.....

Date:

This page is to be retained by participant

UNIVERSITY OF KWAZULU-NATAL
GRADUATE SCHOOL OF BUSINESS AND LEADERSHIP

MBA Research Project

Researcher: Ms. Morwesi Annah Dladla - [REDACTED]

Supervisor: Dr M. Kanyangale - 031 260 7934

Research Office: Ms P. Ximba 031 260 3587

CONSENT

I..... (full names of participant) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating in the research project.

I understand that I am at liberty to withdraw from the project at any time, should I so desire.

Signature of Participant:

Date:

This page is to be retained by researcher

Appendix 3: Language Editor

BRENT'S ART AND LANGUAGE SERVICE CC

8 Rembrandt Street, Vanderbijlpark 1911 * Telephone: 016 – 9325528

Cellphone: [REDACTED] * e-mail: brentboy@lantic.net

CERTIFIED STATEMENT OF EDITING AND TRANSLATION

It is hereby certified that the dissertation:

Green Building Strategy to Mitigate Climate Change: A Case of Department of Public Works in KwaZulu-Natal

By Morwesi Annah Dladla Student number 214580461

has been edited by me, using the Harvard Method, as it is contained in the

Bibliographic Style & reference techniques by Dr Marlene Burger (UNISA, 2010)

Date: 17th February 2020

B.Record BA (HONS), UED, NHDip, M.Tech.

Member of the South African Translators' Institute

Member No. 1002094

BRENT'S ART & LANGUAGE SERVICE CC Registration No. 2000/005438/23

Appendix 4: Ethical Clearance



19 August 2019

Mrs Morwesi Annah Dladla (214580461)
Grad School Of Bus & Leadership
Westville

Dear Mrs Dladla,

Protocol reference number: HSSREC/00000153/2019

Project title: Green Building strategy to mitigate climate change: A case of Department of Public Works in KZN

Full Approval — Expedited Application

This letter serves to notify you that your application received on 01 August 2019 in connection with the above, was reviewed by the Humanities and Social Sciences Research Ethics Committee (HSSREC) and the protocol has been granted FULL APPROVAL

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number. PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

This approval is valid for one year from 19 August 2019.

To ensure uninterrupted approval of this study beyond the approval expiry date, a progress report must be submitted to the Research Office on the appropriate form 2 - 3 months before the expiry date. A close-out report to be submitted when study is finished.

Yours sincerely,

Prof Urmilla Bob
University Dean of Research

/dd