The determinants of the Choice between Green and Conventional Buildings in the Gauteng Office market

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Abstract

The purpose of this study is to identify the key factors which drive investment in or occupancy of green buildings by landlords and tenants and to identify the benefits they derive over traditional buildings. In order to assess the significance of certain factors such as rental, hypothesis tests were conducted with logistic regressions and verified by interviews. Three hypothesis were tested two of which looked at the rentals and operational cost for each type of building , these revealed that the medians as well as distributions of each showed no significant differences between the two type buildings. The last hypothesis test various other factors for any significance between the buildings and no significant findings were found. The importance of sustainability is increasingly being emphasized across industries and more so the property industry given their contribution to greenhouse gas emissions. Green buildings were developed to address these consequences. As such it is important to know the financial returns realized in property portfolio to support the case of green buildings in emerging markets.

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Chapter 1

1.1 **Introduction and Background**

Real estate has a global presence, which is of strategic importance across developed and developing economies. Real estate is as an enabler of economic activity that provides various infrastructure. The development of such infrastructure attracts capital and skills from various industries and sectors of an economy. Furthermore, real estate has the ability to store value and attracts both individuals and institutional investors. Real estate can be classified into one of four broad categories that include 1) Residential 2) Commercial 3) Industrial and 4) Land. The importantance of real estate to organizations remains understated, however, it has increasingly become important to a wider spectrum of stakeholders. The growing importance has facilitated regulatory adjustments to increase the property allocation limit of pension funds, insurance companies and sovereign wealth funds (PWC, 2017) .Corporates have developed real estate strategies that align with their corporate strategies; this has reinforced the significance of real estate.

The estimated value of the South African property market as at the end of the 2014/2015 financial year was approximately R5.8 trillion. (Property sector charter council, 2016). The commercial property sector (retail, offices, and industrial) constitutes R1.3 trillion of the total property industry in South Africa and office space constitutes R357 billion. (Property sector charter council, 2016). According to an article by SA commercial prop News (2016) "*mining and quarrying were the 2 most negative contributors to GDP growth, falling by 18.1% the strongest performer in value add to GDP was the real estate and financial service sector which increased by 1.9% as at the third quarter in 2016"* . This confirms the size of the sector and its relative contribution to the gross domestic product of the country. As such it is progressively more important to find innovative ways to create more energy efficient, economically viable and water efficient buildings. In this quest for innovation due consideration is given to a building's use, life span and sustainability in its environment, from building conception to occupation and beyond.

A well explored phenomenon has recently been introduced to the South African property sector in the form of green buildings.These are building which meets specific design, construction and operational specifications and qualifies to be categorised as a green building. From an operational perspective a green buildings eliminates negative impacts and creates positive impacts on its environment and climate. Green buildings are considered to be energy, water and resource efficient. They make use of renewable energy, considers the environment in design,

adapts to changing environments and considers the quality of life of its occupants. (World green building council, 2016-2018)

The concept and understanding behind green buildings has been gaining popularity since the early 90`s in international western markets such as Australia and the United States. Australians were the pioneers of green buildings, creating the scope and landscape whereas the US forged ahead in the Research and Development space regarding green building. The South African green building industry is a mere 12 years old (GBCSA, 2016) with the Green Building council of South Africa as the custodians of sustainable development through green development. To this end they have promoted the green building movement through numerous tools that assist property owners, developers, and tenants to improve the sustainability of their new and old buildings. An increasing number of stakeholders have found that aligning and incorporating green building initiatives within their corporate strategies has an invaluable role in aligning and increasing revenue, labor productivity and establishing a distinct corporate identity for the majority of corporations and businesses. This study will identify the key factors that stakeholders and tenants in the Gauteng office market consider when having to choose between green and conventional real estate.

1.2 Problem statement

One of the key decisions taken by developers, property owners, and tenants is to decide whether to build and or occupy green building spaces. There is a commonplace perception that green buildings cost a premium to erect, refurbish and maintain. A recent study by the Green Building Council of South Africa (2016) has proven that the average cost premium for building a Green Building is between 1- 5% higher than having to build a similar conventional building[1]. The premium in costs is not the only factor that is considered by landlords and tenants. Greater considerations are given to the changing business environment and landscape relative to the consideration of costs in isolation. Additional factors that are taken into account include corporate identity as well as the availability of space in the market. Therefore, one needs to understand the mechanism used to evaluate the choices between green buildings versus conventional buildings in the Gauteng office market whilst furthermore taking into consideration the extended amount of resources that may be needed to conclude this mechanism of choice between green and conventional buildings.

[1] Green building council 2016: http://constructionreviewonline.com/2016/07/building-green-costs-on-average-only-5-more-than-conventional-building-study/

1.3 Research question

The primary research question of this study is:

What are the financial and non-financial factors driving the choice between green and conventional buildings?

The reason for the question is that there is often an automatic assumption applied that going green leads to a decrease in operating cost and thus has positive net effect on value of a property, the sustainability of these interventions and changes to a building is examined in this paper.

A number of ancillary questions will be investigated to analyze why industries choose to occupy, lease and own green or conventional buildings.

The questions are as follows:

What is the primary reason for occupying green office buildings?

What are the primary reasons for occupying conventional office buildings?

These ancillary question will contribute to answering the primary research question of this study.

1.4 Objectives of study

The primary objective of the study is to understand the key factors driving the choice between green and conventional buildings in the Gauteng office market. The Gauteng province is the economic hub of South Africa and caters to the headquarters of a large number of major South African and multinational corporations. Gauteng is also home to the largest population of green buildings. The study will focus on the key factors that drive tenants to occupy green over conventional buildings, these choices are not only influenced by the tenant but also by developers and landlords that equally create and own green and conventional buildings. Furthermore, this study will seek to create a framework of understanding the choices between Green and Conventional building from a tenant as well as landlord perspective whilst highlighting the significant advantages and disadvantages of each choice of building.

1.5 Hypotheses

The robust debate surrounding green buildings in earlier studies has often examined upfront cost of green buildings. The hypothesis set out stem from a study by Nils, Kok and Quigley (2009) in the US environment using LEED rated buildings.

The following hypothesis will be tested in this study:

> **Hypothesis 1:** The medians of rents, rents per square meter, operating costs, operating costs per square meter are significantly different between green and conventional buildings.

This will aim to prove that there is a distinct financial difference between green and conventional buildings with specific areas in operating costs and rentals.

> **Hypothesis 2:** The distribution of rents, rents per square meter, operating costs, operating costs per square meter is different between green and conventional buildings.
>
> **Hypothesis 3:** Firm Type, JSE Industry Classification, Net Rent per m^2, Operational cost per m^2, Rates and Taxes per m^2, Gross rental per m^2 and Lease Period influence the likelihood a firm will choose green over a conventional building

The categories presented in the third hypothesis is tested for significance as a key factor or not, previous studies all relate to upfront cost in construction and design.

1.6 Justification of the study.

"*Buildings are estimated to be responsible for 20% greenhouse gas emission*."(Stern, Peters, Bakshi, Bowen, Cameron, Catovsky, 2006). Whilst sustainability becomes a greater focus for organizations big and small alike, in order for these organizations to uphold sustainable practices and to lead by example they implement Green building strategies and opt to occupy Green buildings. As a result, Green buildings have gained immense popularity over time. Corporations have found themselves engaging with landlords and developers to fulfill their Green or sustainable requirements, yet the understanding and the financial implications of understanding green concepts is found to be lacking. Therefore this study will seek to confirm understating and improve the knowledgebase behind the benefits of green buildings over conventional buildings

1.7 Scope and limitations

The scope of this study is restricted to South Africa and more so the Gauteng Office market The study is limited to the Gauteng office market nodes of Sandton, Midrand, East and West rand and Pretoria. The Johannesburg and Pretoria central business district`s (CBD) office space are excluded from this study, due to the lack of Green rated buildings in these nodes.

Table 1 (Annexure A) presents all Green buildings in South Africa and Gauteng rated by a GBCSA tool. The scope of buildings that will be reviewed in this study is limited to buildings rated by the "*Green Star SA- Existing Building Performance tool v1*." Tool. Most of the green buildings are refurbished green buildings as the tool suggest.

Conventional buildings will be limited to buildings that are P-grade (Premium) or A-grade in nature. All buildings graded B-C will be excluded to ensure comparability between green and conventional buildings. Conventional buildings are graded by way of the age of the building, speciation of finishes, locality and rental demand. (SAPOA)

Secondary data in the form of tenancy schedules from a chosen portfolio is examined. The portfolio is South Africa`s largest portfolio with an asset value of R 122.3 billion, which has been listed on the JSE since 1987 with a total of 547 buildings and 7.4 million square meters of space. Due to confidentiality reasons the fund cannot be named. The tenancy schedules reviewed is restricted to 1 year-period schedules as at the end of 2016 due to the variable movements that may occur like increases in rates, rental escalations, operating expenses and the like.

1.8 Assumptions

The assumptions to the study are that the service industry includes financial services, which are limited to banks, insurance institutions, accounting firms and law firms. Non-profit organisations are any registered NGO and the Government is national, provincial and local government departments inclusive of state-owned and operated companies such as Eskom. International tenants are tenants that are domiciled outside of South Africa.

All buildings are rated using the Green star Office toolv1, the sample of buildings are limited to buildings not older than 10 years unless recently renovated within a prime location.

Interviews are limited to professionals in the building and property industry with no less than10 years' experience.

1.9 Structure of the study.

This study is organized into five chapters. Chapter two accounts for the literature and past work studied and tested in the field of green building. It gives a comprehensive overview of the content available and investigate the gaps that are found in previous studies. Chapter 3 describes the research methodology applied to this study. Chapter 4 tests the hypothesis as set

out in chapter 1. Chapter 5 gives a summary of the findings and presents further recommendations for future studies.

Chapter 2

Literature Review

2. Introduction

2.1. Purpose and scope of review

This review discusses prior research on corporate real estate management (CREM) decisions. The review of these papers will also uncover the impact that CREM decisions have on sustainable green initiatives. Clear definitions or terms within the text will be established. This exercise resurfaces the previously isolated key drivers that inform decisions with respect to green buildings and implementation processes. Furthermore, the literature review will set the scene for the demystification of the decision drivers in the choice between green and conventional buildings identifying the South African context. The research gaps will be evident, paving the way for a robust research concerning sustainable green building decision making in South Africa. This review will conclude with a post review reconciliation of the important aspects that need addressing in this space. The conclusion provides potential solutions to areas where defects exists but will conclude with the open caveat that much work needs to be done.

Three authors need special mention when engaging with this topic. These authors are instrumental in having dominated the green building field of study most recently from 2010 to present , especially with regards to the US market , John Quigley, Peter Eichholtz, and Nils Kok. Thus, the literature review references numerous works from these authors throughout. Noting the US is the most mature property market concerning green and conventional building.

2.2 Background.

Real estate as an asset class has always been and remains a desired asset class amongst various investors. According to the MSCI (2016) "*Real estate assets outperformed equities and bonds, which achieved 2.6%, 1.6%, respectively. The index also marked investors' gradual and continued structural shift in asset allocation to real estate*." This supports the movement by asset managers, developers, bankers and private equity firms. These stakeholders have identified real estate as an asset class for continued and stable growth. Real estate as a preferred asset class has managed to grow from a mere 5% in 1995 to 24% in 2016 from a global asset allocation perspective (MSCI, 2016).

As markets progress, as is with any asset class, there are new dynamics and nuisances that are introduced that seek to improve, or that may detract from the asset class over time. These concerns or dynamics identified include matters surrounding the use and function around corporate real estate, its management and strategy, the factors of sustainability and the drivers of green building,

2.3 Issues in Corporate Real Estate

2.3.1 What is corporate real estate?

The term corporate real estate is defined as the use of real estate or more commonly termed property as part of a business operation and its associated activities (Brueggeman & Fisher, 2008). This definition is further expanded by Brown (1993) cited in Ali et al (2008) and includes properties that are owned and or leased by businesses to achieve their corporate objectives.

Corporate real estate includes both properties used for operational purposes as well as investment purposes. (Liow & Ooi, 2004). The rationale behind the broader definition of corporate real estate is due to the increased changing business environments as well as the use of real estate by non-property businesses to diversify business risk. (Liow & Ooi, 2004).

Given an understanding of what and who uses real estate gives greater context understanding to the management of corporate real estate as well as the strategic intent behind corporate real estate.

2.3.2 Who uses office space?

Through the evolution of the workforce from industrialized nations to service nations, the use and need for space has evolved from that of industrial factories to the extended need for office space (Lindholm & Levainen ,2006). The number of studies regarding office space has increased tremendously, having to understand booms and bust periods and more recently the evolution of what office space will become and who will end up occupying offices if at all.

A study by Kok, Quigley, and Eichholtz (2009) reveals that various industries constitute the real estate sector, these industries and corporations that take up and occupy office space include banks, insurance firms, law firms as well as oil and gas headquarters. These, however, are not the only industries and corporations but often include government organization as well as non-profit organizations (NPO`s). Many defined as part of the service industry or industries with a well-skilled labor force as expressed by Roulac (1981).

2.3.3 The choices behind corporate real estate.

There are various considerations that relate to corporate real estate for all organizations. Location theory has always been a primary influence amongst all real estate decisions, early scholars of the theory have revolved the theory around cost and its influence on the type of firm. Location cost typically considered by firms include cost of labor, labor availability and technical infrastructure (Kimelberg & Williams, 2013).

Geltner, Miller, Clayton & Eichholtz (2001) expand upon the location theory by introducing the basic economic principle of supply and demand, noting that this theory is location and type

specific to a business or type of property. Therefore ensuring properties are built fit for use (i.e. a coffee shop can only take up a retail space as opposed to an office block). The primary geographic area for offices is commonly found in metropolitan areas and sub-areas such as central business districts.

Having touched on the drivers of corporate real estate, further discussion is required when CRE is used in a strategic sense to organizations.

2.4 Corporate Real Estate Strategy

2.4.1 Real estate and Strategy.

The term strategy is defined by Johnson Scholes and Whittington (2008) as "*the ability to direct an organization over an extended period of time within specific parameters, which aims to achieve a better advantage through the more effective use of its resources and competencies whilst fulfilling stakeholder expectations".* Real estate that an organization utilizes (occupies and or owns) has the ability to have a direct impact on its strategy and ultimately its performance Roulac (2001). Land, labour , and capital are three of the most important resources in any organization. Real estate is often a significant assets on the balance sheet of most corporations. As such corporate real estate has the ability to be used as part of an organization and its associated activities to enhance shareholder wealth (Brueggeman & Fisher, 2008).

It has been brought to the attention of organizations that with the increase in globalization in business operations and notwithstanding the increase in competitive pressure, these factors that have led many corporations having to re-evaluate their real estate needs and to seek greater efficiency in the spaces they choose to occupy (Lindholm, Levanein & Kari, 2009). This statement is reiterated by Roulac, Adair, McGreal et al (2003) emphasizing that global competitiveness and technological innovation will lead more and more corporations and businesses to rethink and transform their corporate real estate portfolios in order to increase their competitive edge and maintain their market share. Hence having a strategic plan , has the proven ability to contribute to the financial success of a business but, it is subjective to facts that business would need to identify the critical drivers for success in their functional strategies including their real estate strategies (Kaplan Norton 2000 cited Lindholm, Gibler 2009)

Roulac et al (2003) conclude that a corporate business strategy addresses key elements of a business such as the environment the business operates within, the interaction with customers, its accommodation for its employees etc. Corporate real estate strategies are yet to be widely adopted as a component of most corporate strategies. One of the reasons behind this, is simply

that strategists have neglected to find the connection or the significance of real estate as an asset in their organization (Roulac, (1993) cited in Ali et al, 2003). Ali et al highlighted in their Malaysian case that "*strategically managed corporate real estate could potentially contribute to enhancing shareholders wealth, however their research suggest that CRE strategy is subject to change across time depending on the changes in the economy and business environment in which companies are competing*" This must be taken into account for all industries but does not take away from the importance that corporate real estate has to increase shareholder value as well as the growing call by governments in terms of regulation that insist that environmental strategies be adopted and adhered to.

Corporate real estate strategies should include flexible lease terms, better used for technological advances to compliment corporates' core businesses, as well as better space management to deliver optimal space requirements for corporations. (Roulac et al, 2003). All this can be regarded as irrelevant if the right people are not interested in driving these strategies. In the study by Allard and Barber (2003), they looked at the impact key real estate factors have on business strategies and if they were effective in strategy implementation; the study was designed around CEOs of select corporations. The study does recognize that if a strategy is to add value to the organization it requires the correct amount of synchronization of multiple factors. Three key critical factors that contribute to an effective business strategy in relation to its real estate strategy are: Company pride (company culture), real estate and workplace design, and real estate relocation.

In order for a corporate real estate strategy to be embedded into a business strategy it needs to address objectives that are addressed by the business unit's strategy. This allows corporate executives to demonstrate their value to the business. (Scheffer, Singer & Van Meerwijk, 2006). It is noted by Ail et al (2008) that there is a key difference between property management, facilities management, and corporate real estate management. The core difference highlighted is that property management looks at building maintenance, facilities management seeks to provide a quality working environment to support a business operation. Corporate real estate looks at strategic real estate activities to support the organization. This is highlighted in order to understand its strategic role and value add that strategic corporate real estate has on corporations.

2.5 Corporate real estate management.

2.5.1Defining corporate real estate management.

The management of corporate real estate is the ability to strategically use real estate to support business operations, activities and compliment business strategy. Corporate real estate management differs from the concept of property management which relates to the day-to-day execution of tasks that enables real estate assets to function correctly each day. (Brown et al(1993), cited in Ali 2000)

Bon (1992) further expands the definition of corporate real estate management as follows: "Corporate real estate management tends to relate a service provided to an organization whose core business is not real estate where corporate real estate management is to contribute to an organization's performance by ensuring the real estate portfolio is in alignment with its business strategy."

2.5.2 Why corporate real estate management?

Industries are increasingly pressurized to optimize their bottom line and create greater shareholder value with the ever-changing economic climate and technological gains. Corporate real estate managers have had to evolve themselves from reactive orientated managers to proactive orientated managers who are able to respond to and provide all stakeholder needs whilst continually enhancing stakeholder value. Corporate real estate managers have evolved themselves from managers of physical assets (bricks and mortar) to managers that move these physical assets from an operational role to a more strategic role within and organization (Omar & Heywood ,2014)

Many corporations have had to decide on either an in-house corporate real estate manager or an external real estate manager. Nevertheless, corporate real estate management is encouraged as the value added, has been found in its potential to enhance a corporation's balance sheet.

2.5.3 The Value-added from Strategic Corporate Real Estate Management

In order for corporations to benefit from a Corporate real estate strategy and management. An understanding of their landscape is key to contributing to the value-add of having a corporate real estate strategy**,** some general assumptions are required initially to gain insight into the corporation's position relative to an industry standard (Roulac, Adair McGreal et al ,2003**).**

Haynes , Nunnington and Eccles (2010) highlight that by making use of corporate real estate management , asset managers , developers and tenants alike have the ability to align an organization process , position and paradigm . In terms of its position it relates to a comparative

environmental relevance to its competitors. Purpose allows the organization to set clear objectives in its environment and relay this effectively towards its workforce and lastly its paradigm this is in relation to how the business culture is set. Therefore all these together allow for better strategic placement and management.

2.6 Sustainability

2.6.1 Defining Sustainability

A number of organizations have noted the need for an increased awareness around the universality of sustainability and sustainable development. There has been substantial growth from the initial concept as depicted by the Brundtland report of 1987 defining *"Sustainable development involving the simultaneous pursuit of economic prosperity, environmental quality, and social equity. Sustainable development is a development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (United Nations: World Commission on Environment and Development Report 1987).*

Sustainability and sustainable development has since evolved beyond the Brundtland report definition. When contextualizing it within the built environment arena, a recent paper by Beradi (2013) investigates this term and gives greater clarity to the term sustainable development. Berandi identifies four key overarching factors that contribute to this definition.

These over-arching factors have a clear influence on the term sustainability. The factors are as follows: time, the environmental dimension or context better described as spatial dependence, the third concept dimension sustainability can be divided into social, environmental and economic; and lastly as the ability of the term to be interpreted differently by different people.

Time in relation to sustainability.

Whilst relating the factor of time to the term sustainability Kemp and Martens (2007) point out as per the Brundtland report (1987), sustainability needs to cover a long-term perspective and this raises the question of how long is "long-term" and how does one determine this future. Therefore, as argued by Bagheri and Hjorth (2007), time cannot be a fixed goal; time steadily needs to be evolved over a period. Therefore, the definition of sustainability in terms of time is an equally moving part. This, therefore, introduces the dimension of time to the definition of sustainability that as knowledge increases, therefore, the definition evolves and thus becomes flexible (kemp, Parto & Gibson, 2005).

Spatial dependence in relation to sustainability.

The second factor relates to spatial dependence as highlighted by Brand and Karvonen (2007). One needs to take into consideration the context of the local perspective in which the boundaries

of the definition is to reside. The boundaries of the "local" definition ultimately rolls up into global scaled definition and consideration.

Environmental, Social and Economic dependence in relation to sustainability.

The third factor for consideration is that to which the concept of sustainability relates to the parameters or domains of the environment, social or economic dependence this is expressed by Hueting and Reijnders (2004). Only considering the environmental domain leaves out several other aspects relating to the social and economic domains thus not expressing a balance and well thought through definition.

The ability to interpret the term differently by different people.

The last factor is the ability of different people to interpret and define sustainability differently. Considering the lack of definitive interpretation of the term sustainability one needs to formulate the context that surrounds the definition of sustainability around the building industry, which then lends itself to the term sustainable development and to the evolution of green buildings, terms that are used interchangeability.

2.7. Green Building

As world economies grow, energy demands have grown as a result increased strain has been put onto the ozone layer. In developed countries buildings account for 30-40% of energy use (Asdrubali, Baldinelli , Bianchi , Sambuco , 2015). Khan , Kok and Quigley (2014) have also found that in developed countries, which are driven by service economies, most activities take place in commercial buildings and have experienced an increase in electricity consumption. Noting the importance of electricity as one of the most important sources of energy in any commercial building or service sector apart from human capital. Because of these matters of concern, the concept of green buildings was born.

Green building practices have been defined by the world green building council (2016) as environmentally sustainable buildings, designed, constructed and operated to minimize the environmental impact it has on its surroundings. Energy, water and sustainability are some of the key factors that are graded by the US green building society as well as the Green Building Society in South Africa. Many of the pioneering councils include International green agencies such as the United States green building council and the UK green building council, the Australian green building council and locally South African green building council (GBSA). These Green authorities have established various systems and rating tools that give president to green buildings in the context of each of their climates and economies and each has an overarching theme of sustainability, resource efficiency, and cost saving

2.7.1 Global Green building concepts and assessment tools.

The World Green building council is the custodian of green rating tools. Understanding that most rating tools are used in a voluntary fashion and is not mandatory for any building. Various green building rating tools are found across each continent customized to its environment and needs.

The world's leading assessment tools are Leadership in energy and environment design (LEED, USA) BRE Environmental assessment method (BREEAM , UK) , Green building council of Australia (GBCA, Australia, Hong Kong building environmental assessment method(HK, BEAM) and so on and so forth. Most of these assessment tools are similar covering the basic forms of sustainability as well as having similar rating or scoring assessments. (Zuo,Zhao 2013) The following table will demonstrate the major certification systems and history as well as established criteria for rating:

Basic Information

	LEED	BREEAM	DGNB	HQE	SBTOOL	Green star	Green Star SA
Origin	USA	UK	Germany	France	Canada	Australia	South Africa
Name	Leadership in energy and environmental design	Building Research Establishment Environmental Assessment method	German Sustainable Building Certificate	Haute Qualite Environmentale	Sustainable building tool	Green Star	Green Star SA rating system
Established	1998	1990	2009	1996	2002	2002	2007
Responsible	US Green building council	BRE	Ministry of Housing	Association pour la HQE	iiSBE	Green building council Australia	Green building council South Africa

Criteria

Energy							
Low emissions		x	x		x	x	
renewable energy	x		x	x	x	x	
efficiency	x	x	x	x		x	x
electrical demand	x	x	x	x	x		
low carbon		x	x		x		

refrigerant management	x	x		x			
Water							
Re-use/ Recycling		x	x	x	x	X	x
Water consumption	x	x	x	x			
Site location							
Public transportation	x	x	x	x	x	x	x
Site selection	x	x	x	x	x	x	x
Grace / Elegance				x			
Cyclist facilities	x	x	x				
Indoor environment							
Air quality	x	x		x	x	x	x
Day lighting	x	x		x	x	x	x
Acoustics		x	x	x	x		
thermal	x	x	x	x	x		
smell				x			
hygiene			x	x			
Materials							
Materials reuse	x	x		x	x	x	x
Waste management	x	x	x	x		x	x
Robustness		x	x			x	
Process and management							
Planning			x		x		
Construction phase		x	x				x
Commissioning		x	x	x	x		
Economic issues							
Costs			x		x		x
Life cycle consideration			x				
value stability			x				
Functionality and comfort							
Flexibility/ Adaptability			x	x	x		

Access disabled persons		x	x				x
safety and security					x	x	
			Innovation				
Innovation issues	x	x					

Figure 0.1: Certification systems in their varying complexities.

Given the similarities in each rating system it is noted that ratings aren't the only progressive addition to the building industry. Nelson and Rakau (2010) highlight the fact that building codes across the globe have improved and have become stricter over time. This has led to improving upon the standard of best practice design. Albeit building ratings improve over time, there are limiting factors that remain in the industry regarding green buildings across markets some of which are the inability to establish a universal definition of what constituents a green building as well as the lack of open data resources and metrics in the green building industry. (Nelson and Rakau, 2010) As a result, these may hinder tenant and investor demand and interest and creating potential misalignment in expectations in terms of tenant benefit and property owner costs.

2.7.2 South African Green building concepts and rating tools.

Over the ten year period of the Green building Council of South Africa it has established its own set of rating tools. These tools are similar to those of the Australian green building council due to the similarities in each country with regards to commercial property markets as well as climates as opposed to the likes of the US, the UK, and Europe. The Australian green building council has eight rating tools these include education, office, industrial, health care, public buildings and multi-unit residential along with two pilot tool communities and interiors.(Zuo, Zhao, 2013)

The South African green buildings council includes tools such as the green star tool, the energy, water performance tool as well as a residential tool.

Green buildings are well perceived to be centered around energy and water efficiency. The South African green building tools vary from office, interiors to retail and residential.

The existing building performance tool is the tool used for reviewing offices in this research paper. The existing building performance is the measure and validation of the environmental performance of an existing building in operation. The following grades reflect the following interpretation with regards to its performance.

Rating	**Interpretation**

Green star 1-2	“On the journey to a better green Building”
Green star 3	Good practice
Green star 4	Best practice
Green star 5	South African excellence
Green star 6	World leadership.

Figure 0.2 : Ratings and interpretations

2.7.3 The *drivers of green corporate real estate decisions.*

There are various factors that can be attributed to why corporates should incorporate green buildings in their decision making, whether from an investor perspective or a tenant’s.

The illustration below points to a number of drivers that contribute to the choice of green buildings.

Figure 0.3World Green building council ,sustainable development goals.

2.7.3.1 Green buildings and employee benefits.

A report released by JLL(2011) in conjunction with the New Zealand green building council (2011) highlight the benefits of a sustainable building in relation to employee productivity. The report highlighted the drivers of sustainable buildings as well as looking at the systems that measure productivity and effectiveness. With the increase in economic challenges faced by corporates and more so by corporate real estate executives, these executives are constantly on the lookout to find ways to improve productivity and increase revenue generation. One noticeable method to increase revenue generation, as well as increase profits, is to ensure effective use of one's resources, human resources being a key aspect of this. Earlier studies in this field have found that there are various factors that look at increasing human productivity some of these include personal factors, organizational factors, social factors and the indoor physical environment. The greatest perceived method of increasing productivity is perceived to be related to personal factors such as work satisfaction and motivation. An opportunity invariably overlooked by executives is one making use of their physical environment to increase productivity factors that can be optimized includes indoor air quality, thermal comfort, access to outside views an external space, lighting, and acoustics.

A survey was conducted on 180 buildings (both green and conventioan) by Abbaszadeh ,Zagreus , leher , Huizenga(2006) regading air quality, thermal comfort and accoustincs (Indoor envirmental quality). It was found that green buildings outperformed conventional buildings but found that occupants complained about green buildings not having enough daylight as a result there were refelctions wihin their office screens that were too bright or dark. When questioned about accoustics it was found that layout did not alllow for enough prviacy, as a result a lot of conversations are over heard or people talking too loudly on their telephones. However, occupants of green buildings found that the thermal comfort of the buildings satifacotry as compared to occupants of conventional buildings.

Levels of productivty and health condiitons are considered more favourable in green buildings as compared to conventional buildings . In a study Reis et al (2006) (As citied in Zuo and Zhao (2014) found that the econmic beenfits of green building in terms of absenteeism and productivity should not be over looked , their study found that productivity increased by as much as 25% when people moved from conventional to green buildings and absenteeism decreased notably.

2.7.3.2 Green building and returns and costs.

The debate surrounding returns on green building has always been a contentious one and has been proven and debated back and forth by various authors. The typical measure of a buildings

performance is in relation to either its construction costs or its ability to drive energy and water savings and demanding a rental premium. According to the economist technology report (2004) the cost saving with regards to energy is 30% more in a green building than in a conventional building. Although a cost savings is recognized there is an upfront cost that is notable in the construction phase of the project and is between 4-10% depending on the green star rating aimed to be achieved. (Davis Langdon, 2007). A complimentary study by Lau, Tan , Lee (2009) in Malaysia found that by using integrated design efficiencies , appropriate construction material and operating conditions a clear reduction in energy can be achieved. Design efficiencies include the orientation, natural ventilation and envelope of the building. Materials being subjective to country climate and availability.

There are motivations that contribute to occupiers of green space taking into consideration the economic profitability, the indirect economic effects and the risk factors that are accounted for that drive the motivation to occupy green spaces (Eichholtz et al, 2009).

The typical economic considerations are those largely related to operational cost (water, electricity , rates and taxes) . Because operating costs can be lowered through greener buildings this is evident in the property sector where it has been proven that forty percent of energy consumption and thirty eights percent of carbon dioxide emissions come from properties in the US. By introducing green practices and occupying green space these costs (water, energy, etc.) are often decreased due to the integral design of green buildings which use thirty percent less than conventional buildings (Kats 2003 as cited in Eichholtz et al 2009

2.7.3.4 Green building and water efficiency.

The following authors reiterate the importance of green buildings as stated by the World green building council. The resources that make up a building (energy, water, land) should be more efficiently used in green building than a conventional building (Kats, 2003). Fowler, Rauch , Henderson and Kora (2008) adds to these statements by stating the fact that green buildings are more energy efficient, water conserving, durable and non-toxic with high-quality spaces and with a high content of recycled materials. Berardi (2011) also writes that a building is sustainable if it is built in an ecological orientated way which reduces its impact on its environment.

2.7.3.5 Green building and business districts.

Businesses are generally located around one another in central business districts or commercial nodes. Most business rely on the agglomeration effect where they are grouped together and enjoy the similar benefits to cost , congestion and face to face contact (Nappi-Choulet &

Decamps ,2011) .Following the definition of sustainability that relates to spatial dependence Brand and Karvonen (2007). It has been argued that in the need to obtain sustainable cities a new determinant needs to drive this these include the promotion of sustainable attributes for business districts. These sustainable attributes include green buildings, local amenities these however are not the only attributes soft attributes such as urban renewal, green space, consumption nodes are also included. (Nappi-choulet &Decamps, 2011).Therefore these attributes promote gentrification and sustainable cities not only looking at green buildings in its isolation.

2.7.3.6 Green building and other related factors.

An indirect economic consideration by business is reputation, the use of green buildings and space signals a commitment to stakeholders and clients that the business that employs green practices have a long-standing commitment to an SRI /CSR policy. Therefore, this allows firms and businesses to actively participate in the CSR and SRI policy and gives them the advantage to anticipate changes in legislation and take these changes into consideration sooner rather than later and as a result, reduces economic costs in the long run. (Fisk & Rosenfel (1997), cited by Eichholtz et al, 2009). There is also the notion that although investors may be profit driven there are tenants that pursue CSR policies that exceed the monetary cost of these policies in the long run thus it is imperative for investors and developers to cater to these tenants needs Eichholtz 2009. These practices and policies cumulate into responsibly property investing that allows a triple bottom line to be tracked noting not only the normal parameters of returns but the environmental and social impacts as well.(Social Investment forum , 2007).

Furthermore, legislation and government policies has the ability to play an active role in creating change and further advocating for green buildings.

Lastly, another benefit cited by Eichholtz et al (2009) is that employees of tenants that occupy green buildings have increased productivity level. Several studies that proven to demonstrate a positive correlation between internal environments and employee health and productivity (Apte Fisk 2000 cited by Eichholtz 2009).

2.7.4 Benefits of green corporate real estate decisions.

A common question many catechize, Is there any value in distinguishing between Green real estate and Conventional real estate when adding it to a portfolio or occupying either building? To this, there are positives and negatives, which of these outweighs the other are noted in this paper.

In view of recent studies, there have been mixed reviews and much discussion regarding certified green buildings; as a result, many studies are focused on the cost-related outcomes of

these buildings. There are varying reports and assessments regarding these outcomes some suggest that the initial upfront design benefit may result in as much as a twenty percent savings over its life cycle cost, these studies also suggest that the sales prices for green buildings are as high as ten percent more per square meter as conventional buildings (Kent, Angrisano (2012). Supporting studies by Eichholtz, Kok and Quigley (2010) have found that green rated buildings have the ability to command rentals three percent higher per square foot than those of conventional building. Although fewer studies have focused on the "softer" side of things other than cost, these related benefits studies have however indicated positive performance, better health and comfort by individuals that occupy green buildings, further demonstrating the integral importance that building environmental strategies have to businesses. (Kent, Angrisano (2012) cited Miller et al and Browning and Romm).

The ever-growing interest in the natural environment is further supported by Arago´ n-Correa and Rubio-Lo´pez (2007) in their study about environmental strategy myths and misunderstandings. Kotter and Heskett (1992) have highlighted that "many real estate decisions have an indirect and lagged effect on a firm's financial success that goes unmeasured as financial performance is correlated with the creation of value and delivery of quality products or services." (Roulac (2001) cited by Ali, Mcfreal). James emphasizes the importance of corporate real estate strategies and highlights the advantages of these strategies. that the competitive advantage of a business is improved through the creation and retention of customers by attracting and retaining outstanding people these people are given the ability to contribute to the business process, promote enterprise values and cultures whilst stimulating innovation and enhancing core competency thus in return creating shareholder value

2.8 Literature gaps

Studies on green buildings mostly focus on the US and Australia in developed markets. These are well depicted by the authors Quigley and Kok. Only most recently Singapore, which represents a developing economy, has research been undertaken. The number of studies that relate to the African real estate portfolio is limited as is the number of green building councils and regulatory bodies. These studies have focused on the various parts of the real estate market that include residential, commercial (office) and REITs. Furthermore, these studies have tested the "green" / ecological performance against international standards like LEED. This study looks at testing these hypotheses in an African developing market of corporate real estate.

2.9 Conclusion

In assessing the market place, one notes the intention of green buildings in the market to ensure greater sustainability but furthermore to enhance balance sheets of companies that utilize these assets to their advantage. The framework however, that surrounds green buildings and its positive outcomes has not been customized to developing nations, reasons for this may largely be attributed to the age of the market place. As corporations grow and international corporations enter the market place a better uptake of green proposals can be considered whilst ensuring a comparative analysis of the two types of buildings in the market place.

Chapter 3

Research methodology

3.1 Introduction

The following chapter delves into the research methodology that has been used to support the objectives of the study and test its hypothesis. The chapter reviews the data types as well as the methods of sourcing data. It reviews the approach and appropriate use of the regression analysis as well as motivates the use as shown in previous studies in use of the current research design.

3.2 Data Types and Data Sources

Various and comprehensive property data sources are readily available in international markets such as the US, UK and Australia, due to regulation and competition in the market place.
However, property data in South Africa has been rare to come by especially concerning rentals, operating expenses and capitalisation rates for both conventional and green buildings. With the inception of the Green Building Council of South Africa, property information about Green buildings and their ratings have become more accessible and readily available, however information on conventional building data is still lacking.
Conventional building information other than their grading is not as readily available and information on (rentals, electricity and water charges and consumption) are housed with landlords and management agents of these buildings. Therefore, with the constraints in the market, this study has undertaken to gather data from landlords as well as the green building council of South Africa. A number of requirements for the data regarding the descriptive statistics will inform the independent variables of the regression model. These descriptive statistics are sourced by means of tenancy schedules that have been requested from the largest landlord of both green and conventional buildings

The data collected, is restricted to the Gauteng area due to the number of buildings rated (See table1: Annexure A) and economic presence of the Gauteng office market . Additional data will be collected by way of interviews with senior property practitioners with a minimum of 10 years' experience in the property industry these include senior officials of Banks, asset managers and developers.

3.3 Sampling

3.3.1Sampling methods

There are various sampling methods that can assist one in achieving a reflection of the population. Sampling has three main characteristics and reasons for its use. Samples are taken because it is less time-consuming than selecting the entire population, it is more cost effective

and lastly more practical in analysis than the entire population. However, the sample number selected should be representative of the total population. In order for one to draw a sample one will define the population which is also known as the frame. When choosing the frame, one needs to frame the lists of data sources that will be required, ensuring that these frames are similar. Upon completion of choosing a frame, one uses one of two sampling methods: non-probability sampling or probability sampling. (Bereson et al, 2012). In this dissertation, the probability sampling approach because of the fact that the samples have been selected based on known probabilities.

3.3.2Probability sampling

The use of probability sampling is a method used when one is able to select items with known probabilities. Making use of this method of sampling allows for unbiased inferences to be decided upon regarding the population. This study will make use of probability sampling more specifically stratified sampling and simple random sampling. Stratified probability sampling requires one to define a stratum which is the number of frames. (Berson et al, *2012)*. Thus in this study, the researcher will have use N that represents the frame and (n)to present the frame, in this study, the N will be pre-determined property nodes that contain both green and conventional buildings within each node the researcher will then select a number (n) of buildings for testing. The (n) number of building for testing will be made by making use of simple random sampling, the use of simple random is to ensure that the sample will be reflective of the entire population further and that the sample will be characterized by common characteristics of each building. (Bereson et al, 2012).

3.3.3Choosing the sample size

The choice of the sample size is largely dependent on the population size. The determinants of this include ensuring that there is a margin of error accounted for this is generally accounted for. The sample size must be a proportionate number reflective of the population that will allow the researcher to infer certain characteristics that are innate to the population. The sample size was drawn from a population where a number of property firms were approached but only one firm considered the response.

3.4 Data collection approach

3.4.1 Interviews and Questionnaires

A questionnaire is simply a tool that is regularly used to collect and record information for research purposes. A questionnaire can take on the form of a survey or interview. Each survey or interview should have a definite purpose and objective that relates to the study. An advantage of using a survey is that it has a relatively low cost associated with it, and can be easily spread. The disadvantage is that one may receive a low response rate and sometimes little control over who completes the survey.[2] Whereas with an Interview the disadvantage is that it is time consuming , but an advantage is that one may target the correct person while ensuring clarity in questions and the ability to elaborate where needed.
Interviews were conducted with professionals in the property market.

3.4.2 Ethical considerations.

When one is to administer any form of the following tools to gather information, an interview, questionnaire or survey one will need to take account for ethical consequences that may result from one`s research. Research ethics is the interaction between the people and the surveyor and should not necessarily be confused with professional ethics. Some of the most important ethical considerations to consider before administering one`s interview is that one needs to be granted consent from all participants either verbally or written consent prior to engaging. In obtaining consent, one must also allow for the participant to decline to participate and or to withdraw from participating at any point without any negative consequence. An incentive should not be offered to participant for participation in order to ensure no bias is created (Woodsong,, MacQueen, Guest, & Namey, , 2005). In order to achieve maximum results from a survey and or interview the researcher should ensure that the purpose of the research is well explained to the participant. If any confidential information is required one needs to ensure confidentiality is protected at all times, furthermore one is to ensure respect is upheld at all times and where possible feedback should be given to participants. Lastly there should always be a point of reference for the participant to contact if the participant has any queries and or comments regarding the questionnaire, interview or survey. (Fox, Murray, Warm, 2003)

[2] http://www.kirklees.gov.uk/community/yoursay/questionnaires.pdf

3.7 Data analysis techniques

3.7.1 Methodologies in previous studies

The review of previous studies has found that a vast majority of these studies test and interrogate their hypothesis through quantitative methodologies with very few if any combining both quantitative and qualitative studies to test their hypothesis. The most popular method is the use of regression models (both linear and multiple). Dilts and Goldreyer (1999) in their study to test SRI performance of mutual funds made use of qualitative methods and quantitative statistical methods testing the performance of a number of funds, they made use of screening tools and tested the performance statistically against each other over a defined period. This study was then compared to another study where no screening tools were used and the later study where no screening tools were used found no statistical significance in their returns.

Further research previously conducted in this field has concluded on various approaches to testing their hypothesis, some of the most popular approaches are by the use of regression analysis many authors approach is through linear or multiple regression analysis. Studies completed by Nils et al, the authors that dominate this field, have approached their research through various formats most popularity the use of regression analysis and questionnaires that are then tested for validity through regression and correlation significance.

Henrique's and Sadorsky (1996) make use of a questionnaire, collecting data on behaviors of firms in relation to environmental issues. The questionnaire is guided by literature in relation to corporate social responsibility in business and the environment. The questionnaire is directed towards managers or senior officials with knowledge with regards to environmental affairs affecting the business or firm.

Konar and Cohen (2001) look at firms listed within S&P's 500 and look at their market value in relation to their environmental objectives. Previous studies that have tested this relationship between market value and environmental performance tested the relationship in one of two ways one through comparing environmental performance over time or analyzing the effect of environmental performance on the market value of the firm by way of new information i.e.an oil spill etc. Konar et al (2001) differentiating analysis looks at objective measures of environmental performance based on government records and government-mandated sec disclosures, these are not subjective or anecdotal as is the case with previous studies and also not just based on negative outcomes or risks such as oil spills or government enforced actions.

The first step was taken to ensure correct variables are measured, Konar decomposed what market value is and expressed it as MV = Vt + Vi where MV is market value and Vt and Vi are the proportions of tangible and intangible assets of a firm respectively. Konar`s decomposition

of market value is derived from Linderberg and Roos (1981) that looked at different aspects of a firm's valuation that include monopoly power, research, and development etc. The data sets and sources used in this study is limited to industries that were nonpolluting industries as defined by the S&P 500 list.

This research contributes to why companies contribute to environmental –reputation capital and why some are overly committed. The authors(Konar and Cohen) conclude that there is still lack of understand the true relationship between the two whether companies that are profitable and reputable because they are able to afford to do so or , is it that they are highly reputable and contribute to their environment in a positive , to enhance their reputation only.

In a key study completed by Nil, Kok and Quigley (2009) these authors have proposed the following research methodology to test their hypothesis on whether or not companies rent green buildings and why? The methodology outlines industries that participate in the corporate real estate space according to their standard industrial classification (SIC) codes, based on these codes they have classified them into SIC codes and tested and formulated a number of hypotheses to test the hypothesis are a test to the industries.

"*H1: Industries that are dependent on high levels of human capital such as the service sector will be more likely to rent office space in green buildings.*

H2: Space-intensive industries such as the service sector will be more likely to rent an office in green buildings.

H3: Industries characterized by environmentally sensitive operations will be more likely to lease Green office space.

H4: The public sector and other nonprofit institutions will be more likely to lease green space."

The hypothesis was tested by means of descriptive stats and regression models. These hypothesis were set in a US climate making use of LEED rating methodologies.

The following was concluded from the study, industries are becoming more aware of the contribution that the built environments has on greenhouse emissions and energy consumption.

The oil industry is a major occupier of green office space, this is conclusion to the third hypothesis that firms characterized by environmentally sensitive operations are more likely to rent green office space. The second highest industry to occupy green buildings is the legal and financial services firms. Although many of these firms occupy these buildings it was noted that green building are more likely to be occupied because of the features rather than noted for a responsible behavior need. It was further noted that to assist in the implementation of CSR strategies, green buildings hold as a great contributor. Lastly for investors and

developers the upfront cost of green buildings are able to be recouped through energy savings and high premium rentals

3.7.1 Regression analysis

A number of previous studies concerning the real estate market have made use of regression models as a means of analysis. One of the key reasons is because a regression model is a set of statistical techniques that allows one to evaluate various dependent and independent in relation to one another. Gujarati & Porter (2009) have a modern interpretation what a regression demonstrates, it concerns itself with one dependent variable and one or more explanatory variables with the view of estimating the average of the dependent terms. Thus the model may either take the shape of a linear regression or that of a multiple regression.

3.7.2 Linear and Multiple Regression

In the case of a linear regression, it only isolates the dependent and an independent variable in relation to one another. Linear regression is typically applicable to data that has two or more variables, where one wants to determine the relationship between these two variables. The dependent variable is generally known as the responsive variable and the independent variable known as the predictor variables. Multiple regression simply includes more than one independent variable or predictor variable thus it looks at one dependent and multiple independent variables.

The basic regression equation is expressed as follows:

$$Y= \beta_0+\beta_1X_1+ \beta_2X_{2+ \ldots +} \beta_nX_{n+}\varepsilon$$

Where Y is the response variable
B_0 the intercept
X_1, X_2,X_n the predictor variables
B_1 the slope or coefficient of the predictor variables
E represents the random error in the responsive variable. (James, Witten,, Hastie,, and Tibshirani, R., 2013.)

In the preliminary stages of the analysis one determines the strength of the relationships between the dependent and the independent variables. In later and more progressive analysis and uses of regression analysis and methods, one is able to examine the relationship between the dependent

and the independent variables with the effect of one other independent variable statistically being eliminated (Tabachnick & Fidell, 2001). There are various examples of studies that have used and are able to make use of regression models, these studies include where one is able to predict the test scores in an introductory psychology class from an academic ability, measures from the high school GPA (Woehr and Cavell 1993).Another study by Maki, Hoffman, and Berk (1978) used regression analysis to *"predict sales and the production of water from the existence of conservation measures, rainfall season, population.*"

Apart from the above techniques there is a variety of other techniques used within the regression stable. These include standard, multiple, sequential (hierarchical) statically (stepwise) regression the fundamental difference or variances in techniques is the manner in which one is able to assess how the variables enter the equation (Tabachnick et al 2001) .

3.7.3The B value/coefficient.

One of the goals of running a regression is to estimate the coefficients which are generally a set of Beta values. The regression coefficient is estimated using the ordinary least squares method commonly known as the least squares or OLS. The least squares method estimates the regression coefficients in order to minimize the residual sum of squares (RSS). (M Berenson, D Levine, T, Krehbiel (2012).

3.7.4 Ordinary least squares.

The ordinary least squares method is one of the simplest methods used to estimate the regression coefficient. This is generally the most popular method in practice as this practice provides desirable statistical properties such as "estimators *that are linear functions of the dependent variable y, as well as estimators that are unbiased that are repeated application of the method on average the estimators are equal to their true value*." (Gujarati D 2014)

There are varying limitations and advantages while making use of the OLS method the advantages include the easy of understanding the method as well as method of calculations, limitations vary manly according to the data used.

3.7.5 Limitations to regression analysis.

As with any model, due consideration needs to be taken into account to the limitation when making use of any statistical model. When one considers making use of regression as a tool of analysis a number of limitations are considered:

1. Theoretical issues: One flaw is that a regression may reveal a relationship between variables but does not necessarily imply that there is a logical relationship it may just suggest a statistical relationship.
2. Practical assumptions and limitations.
   2.1 Linearity: the relationship between the predictor variables and the responsive variables should be linear
   2.2 Normality: The error terms should be normally distributed
   2.3 Independence: the error associated with one observation should not affect or correlate to any other observation.
   2.4 Homogeneity variance or homoscedastic: the variance of the errors should be constant
   2.5 Model specification: All models should be appropriately and correctly specified.
   2.6 Collinearity: predictor variables should not be highly collinear. (Tabahnick et al 2001)

3.9 Research design

This study will make use of a regression model more specifically a logistical regression. , the model will determine the responsiveness of tenants to the decision-influencing factors affecting the choice between green buildings over conventional building given a set of prescribed criteria. In order to build the predictive regression model, data from tenancy schedules will be collected of both green buildings and conventional buildings.

The following equation below is the general form of the model that has been in under taking this research. The generic multiple regression is proposed with the following dependent and independent variables.

$Y= \beta_0+\beta_1X_1+ \beta_2X_{2+ \ldots+} \beta_nX_n +\varepsilon$

Y (dependent variable): This variable will be representing the space occupied in a green building or conventional building by a specific user in a specific node also known as gross lettable area. The user will be classified by use of standard industry codes (SIC). The node will be classified as per the Johannesburg city council (COJ) these will be further described with the use of descriptive statistics.

β_0 the intercept

X_1, X_2…Xn (predictor or independent variables): The predictor variable will include and will be limited to the following these will be confirmed by the data set (tenancy schedule).

$X_{1:}$ Gross rental

$X_{2:}$ Operating costs

$X_{3:}$ Rates and Taxes

$X_{4:}$ Net rental.

β_1 the slope or coefficient of the predictor variables

Error term represents the random error in the responsive variable this will be tested by making use of the ordinary least squares method.

3.9.1 Logistic regression

The logistic regression model arises from the desire to model probabilities of multiple classes with linear functions in x, whilst ensuring that the probabilities sum to 1 and always remain in the interval [0; 1]. Logistic regression can be applied to multiple classes; however, it is most often applied to the scenario where a dichotomous or binary outcome is observed. In the specific scenario where a binary outcome is observed, this can be thought of as modeling the probability that one of the two outcomes is achieved (Gujarati D 2014)

3.9.2 Research limitations and assumptions.

The following study states the following limitations. All buildings classified as green buildings will have been rated by the Green Building Council of South Africa (GBSA). The buildings have been rated using the office tool as compiled by the Green Building Council. Furthermore, the study will be limited to offices rated across the Johannesburg and Pretoria office sector in the Gauteng region due to time constraints where the study will need to be completed in 2016.

3.10 Conclusion

There are varying methods discussed that will test the hypothesis of this study. The study will make use of a combination of qualitative as well as quantitative methods. The qualitative method will be that of a questionnaire and quantitative method making use of the regression analysis method. This will not only display the data in the best possible form but ensure ease of understanding when analysis the data presented.

Chapter 4

Discussion of Results

4.1 Introduction

This chapter presents an analysis of the data gathered from the study. Secondary data came from a well-known property fund with a national presence in the South African office market. The data analyses covers tenants of 92 office buildings covering key nodes within the Gauteng province. These nodes include Sandton, Rosebank, Midrand and Pretoria but exclude the Pretoria and Johannesburg central business districts. The Pretoria and Johannesburg central business districts are excluded due to buildings that are not comparative to the other nodes i.e. not enough premium buildings exist in these nodes nor is there the requisite number of green buildings as a comparative.

4.2 Data Characteristics

The data analyses include tenant characteristics, net rental, operating costs, property rates and taxes, parking, net rental per square meter, operating cost per sqm, rates per sqm and gross rental per square meter.

Tenants were segmented using industry classification from the Johannesburg Stock Exchange (JSE). Furthermore, tenants were categorized into multi-national, international, national and or local company by identifying each tenants CIPC domicile address and matching it to the ownership.

The sample considered has a total number of 92 buildings, 17 green and 75 conventional building. All conventional buildings considered are A-grade buildings and all green buildings considered are buildings with ratings between 3 and 5-star status. , with the dominant rating being 4 star rated building.

A-grade buildings are defined by the Rode Report as "Buildings *not older than 10 years old unless renovated, prime location, high-quality finishes with adequate parking and air conditioning*."

Green buildings are defined by their rating types with 4 star ratings obtaining a score of 45-59 and is recognized as best practice, and buildings rated as 5 stars considered excellent by South African standards, scoring between 60 and 74 and the highest star rated building a six-star building is recognized as a world leader and scores between 75 and 100. (See annexure B: Characteristics for each green building rating).

Furthermore, primary data concluded and gathered in the form of interviews were conducted with ten industry professionals who range in background from developers, property owners, property managers and green consultants. Interviews were conducted concurrently whilst gathering the secondary data set. The professionals interviewed have a minimum of 10 years' experience each, in the property industry as well within their designated roles.

4.2 Results

The tables that follow below reflect how the data is segmented into the number of buildings within the sample size, the number of tenants in each building and further categorized by tenant type and firm type.

4.1.1 Building and tenant type

Table 1 below represents the sample size of buildings.

	Number of buildings
Green	**17**
Conventional	**75**
Total	**92**

Table 1: Sample size of green and conventional buildings

Table 2, below is a distribution of green and conventional buildings per rating type, as rated in the case of green buildings or graded in the case of conventional buildings. The majority of tenants that occupy green buildings have a preference for 4 star rated buildings. In the case of conventional buildings, the majority of tenants occupy A-grade office space.

Rating type	Green tenants	Conventional tenants
3- star	182	0
4-star	210	0
Premium	0	40
A-grade	0	1591
B-grade.	0	581
Total	392	2212

Table 2: The distribution of green and conventional buildings per building rating type.

Table 3 below, represents a cross tabulation between firm type and building type. The number of tenants occupying conventional buildings is higher than green buildings with 970 tenants occupying conventional buildings with 156 tenants occupying green buildings.

Firm type	Green	Conventional
Multinational	12	135
International	115	412
National	156	970
Local	48	264
Vacant	61	431
Totals	392	2212

Table 3 : The distribution of Firm type in Green and Conventional buildings

Table 4 below, represents a cross tabulation of the number and the types of tenants that occupy green and conventional buildings. Tenant types range from banks to firms in the telecommunication industry. There is a total of 2604 tenants, 2212 occupying conventional buildings and 392 occupying green buildings. A 75% -25% split across the buildings. The dominant tenant type in conventional buildings includes professional services, consumer goods, government and insurance companies in order of popularity. Similarly in green buildings financial services, real estate professionals, government and consumer services in order of popularity.

Tenant type	Green	Green tenants as a percentage	Proportional percentage to total buildings Green	Conventional (number)	Proportional percentage to total buildings conventional	Conventional Expressed as percentage	Total
Banks	15	24.59%	0.58%	46	1.77%	75.41%	61
Basic materials	5	38.46%	0.19%	8	0.31%	61.54%	13
Basic resources	5	71.43%	0.19%	2	0.08%	28.57%	7
Chemical	1	7.69%	0.04%	12	0.46%	92.31%	13
Church	0	0.00%	0.00%	1	0.04%	100.00%	1
common areas	3	15.79%	0.12%	16	0.61%	84.21%	19
Construction and materials	2	10.00%	0.08%	18	0.69%	90.00%	20
consultants/ private person	25	22.12%	0.96%	88	3.38%	77.88%	113
consumer goods	22	13.17%	0.84%	145	5.57%	86.83%	167
Consumer services	33	13.75%	1.27%	207	7.95%	86.25%	240
Educations	1	2.13%	0.04%	46	1.77%	97.87%	47
Financial services	44	24.04%	1.69%	139	5.34%	75.96%	183
Financials	0	0.00%	0.00%	17	0.65%	100.00%	17
Government	29	18.13%	1.11%	131	5.03%	81.88%	160
health care	9	11.25%	0.35%	71	2.73%	88.75%	80
Industrial engineering	8	47.06%	0.31%	9	0.35%	52.94%	17
Industrial goods and services	4	9.30%	0.15%	39	1.50%	90.70%	43
Industrial metals and mining	9	14.06%	0.35%	55	2.11%	85.94%	64
Industrial transportation	0	0.00%	0.00%	18	0.69%	100.00%	18
Insurance	11	8.80%	0.42%	114	4.38%	91.20%	125
NGO`s	1	5.00%	0.04%	19	0.73%	95.00%	20
oil and gas	0	0.00%	0.00%	9	0.35%	100.00%	9
Professional services	36	10.68%	1.38%	301	11.56%	89.32%	337
Real estate professionals	38	53.52%	1.46%	33	1.27%	46.48%	71
technology	19	9.84%	0.73%	174	6.68%	90.16%	193
telecommunications	11	15.49%	0.42%	60	2.30%	84.51%	71
Utilities	0	0.00%	0.00%	11	0.42%	100.00%	11
Vacant	61	12.60%	2.34%	423	16.24%	87.40%	484
Totals	392	15.05%	15.05%	2212	84.95%	84.95%	2604

Table 4 Distribution of tenant type per building in proportion relative to the entire building sample.

4.2 Building location, size, and economic characteristics

The following information below is a representation of the means and standard deviations of gross, net rents and operating costs, segmented into each node.

4.2.1 Sandton

Average: Sandton	Net rent (R /sq.)	Op costs/ sq.	Rates/sq.	Gross/sq.
Green	123,75	28,55	24,27	167,12
Conventional	109,81	28,99	15,03	130,84
Total	111,94	28,90	16,59	137,09

Table 5 The medians of net rent , Op Cost ,rates and Gross rent /m2 : Sandton.

Std Dev : Sandton	Net rent (R/sq.	Op costs/ sq.	Rates	Gross/sq.
Green	48,88	4,76	3,31	109,32
Conventional	101,97	20,41	14,55	105,11
total	95,90	18,31	13,77	106,67

Table 6 The standard deviation of net rent , Op cost and Gross rent /m2 : Sandton

The average net rent, operation cost, rates and gross for green properties in Sandton is 123.75, 28.55, 24.27 and 167.12 respectively. The average net rent, operation cost, rates and gross for conventional properties in Sandton is 109.81, 28.99, 15.03 and 130.84 respectively. Comparatively, the average net rent, rates and gross for green buildings are higher than conventional while the average operating cost for conventional building is higher than that for green buildings.

4.2.2 Rosebank

Average: Rosebank	Net rent /sq.	Op costs/ sq.	Rates	Gross/sq.
Green	79,41	22,88	73,26	136,31
Conventional	86,86	30,84	13,74	108,93
total	85,75	29,46	24,56	112,99

Table 7 The medians of net rent , Op Cost ,rates and Gross rent /m2: Rosebank

Std Dev : Rosebank	Net rent /sq.	Op costs/ sq.	Rates	Gross/sq.
Green	35,39	8,69	66,14	44,87
Conventional	38,23	7,49	8,96	52,79
total	37,84	8,26	36,88	52,52

Table 8: The standard deviation of net rent, Op cost and Gross rent /m2: Rosebank

The average net rent, operation cost, rates and gross rent per square meter for green buildings in Rosebank is 79.41, 22.88, 73.26 and 136.31. The average net rent, operating cost, rates and gross for conventional properties in Rosebank is 86.86, 30.84, 13.74 and 108.93 respectively. Comparatively, the average net rent and operating cost for green buildings are lower than conventional while the average rate and gross for green building is higher than conventional building.

4.2.3 Midrand

Average: Midrand	Net rent /sq.	Op costs/ sq.	Rates	Gross/sq.
Green	84,55	17,45	10,44	106,13
Conventional	66,01	24,73	8,79	88,36
Total	83,93	17,65	10,40	105,54

Table 9 The medians of net rent , Op Cost ,rates and Gross rent /m2: Midrand

Std Dev: Midrand	Net rent /sq.	Op costs/ sq.	Rates	Gross/sq.
Green	30,96	4,29	3,46	40,90
Conventional	18,20	6,04	0,18	37,87
Total	30,73	4,46	3,42	40,73

Table 10: The standard deviation of net rent, Op cost and Gross rent /m2 : Midrand

The average net rent, operation cost, rates and gross for green buildings in Midrand is 84.55, 17.45, 10.44, and 106.13/sq. respectively. The average net rent, operation cost, rates and gross for conventional properties in Midrand is 66.01, 24.73, 8.79 and 88.36/sq. respectively. Comparatively, the average net rent, rates and gross for green buildings are higher than conventional while the average operation cost for conventional buildings is higher than green buildings.

4.2.4 Pretoria

Average : Pretoria	Net rent /sq.	Op costs/ sq.	Rates	Gross/sq.
Green	73,90	27,95	17,00	96,37
Conventional	271,65	22,54	14,73	299,71
Total	268,80	22,59	14,75	296,79

Table 11: The medians of net rent , Op Cost ,rates and Gross rent /m2: Pretoria

Std Dev: Pta	Net rent /sq.	Op costs/ sq.	Rates	Gross/sq.
Green	19,79	-	-	51,58
Conventional	1 983,12	7,87	7,42	1 980,85
Total	1 968,84	7,85	7,39	1 966,60

Table 12: The standard deviation of net rent, Op cost and Gross rent /m2 : Pretoria

The average net rent, operation cost, rates and gross for green properties in Pretoria is 73.90, 27.95, 17 and 96.37/sq. respectively. The average net rent, operation cost, rates and gross for conventional properties in Pretoria is 271.65, 22.54, 14.73 and 299.71/sq. respectively. Comparatively, the average net rent and gross for green buildings are lower than conventional buildings while the average operation cost and rate for conventional building is lower than that of green buildings.

4.2.5 East rand

Average: East Rand	Net rent /sq.	Op costs/ sq.	Rates	Gross/sq.
Green	111,94	0	8,49	114,77
Conventional	3 139,81	44,82	220,13	3 367,41
Total	2 130,52	44,82	189,90	2 283,20

Table 13 The medians of net rent , Op Cost ,rates and Gross rent /m2: East Rand

Std Dev: East Rand	Net rent /sq.	Op costs/ sq.	Rates	Gross/sq.
Green	62,25	0	0	64,84
Conventional	7 391,66	-	524,47	7 912,62
Total	6 036,62	-	485,41	6 463,51

Table 14: The standard deviation of net rent, Op cost and Gross rent /m2 : East rand

The average net rent, operation cost, rates and gross for green properties in East rand is 111.94, 0, 8.49 and 114.77/sq. respectively. The average net rent, operation cost, rates and gross for conventional properties in East rand is 3139.81, 44.82, 220.13 and 3367.41 respectively. Comparatively, the average net rent, rates and gross for green buildings are lower than conventional .

4.2.6 Braamfontein

Average: Braamfontein	Net rent /sq.	Op costs/ sq.	Rates	Gross/sq.
Green				
Conventional	173,35	58,21	13,92	218,63
Total				

Table 15 The medians of net rent , Op Cost ,rates and Gross rent /m2: Braamfontein

Std Dev: Braamfontein	Net rent /sq.	Op costs/ sq.	Rates	Gross/sq.
Green				
Conventional	120,51	56,95	8,92	140,46
Total				

Table 16 The standard deviation of net rent, Op cost and Gross rent /m2 : Braamfontein

The average net rent, operation cost, rates and gross for conventional properties in Braamfontein is 173.35, 58.21, 13.92 and 218.63 respectively. It is noted that a comparative green buildings were not found in this node.

4.2.7 West rand

Average: west Rand	Net rent /sq.	Op costs/ sq.	Rates	Gross/sq.
Green	99,44	16,84	9,46	112,59
Conventional	78,08	23,10	15,86	105,16
Total	78,50	23,01	15,77	105,30

Table 17: The medians of net rent , Op Cost ,rates and Gross rent /m2: West Rand

Std Dev : West rand	Net rent /sq.	Op costs/ sq.	Rates	Gross/sq.
Green	58,15	0	0	76,74
Conventional	21,19	1,83	1,85	33,54
Total	21,97	1,96	1,99	34,09

Table 18: The standard deviation of net rent, Op cost and Gross rent /m2 : West rand

The average net rent, operation cost, rates and gross for green properties in West rand is 99.44, 16.84, 9.46 and 112.59 respectively. The average net rent, operation cost, rates and gross for conventional properties in West rand is 78.08, 23.10, 15.86 and 105.16 respectively. Comparatively, the average net rent and gross for green buildings are higher than conventional while the average operation cost and rates for conventional building is higher than green building.

4.3 Hypotheses tests

The following hypothesis test were conducted to establish if there are any significant differences in the distribution of medians of the financial variables described above that may explain why tenants would choose a green building over a conventional building. Or if any of the elements are factors that play a distinct role in the choices between the two buildings.

4.3.1 Independent Sample median test.

The independent sample median is a test that analyzes whether the median from the samples (green and conventional buildings) are equal or different to one another. The null hypothesis is where the medians of the net rents, operational cost , gross rents, rent/sq , operational cost/sq and gross rent/sq are the same across the samples of building, the alternate hypothesis is where the net rents , operational cost , gross rents , net rents /sq , gross rents /sq operational gross/sq is not the same across the samples(Green versus conventional)

4.3.2 Mann- Whitney U test.

The Mann-Whitney U test is used to ascertain whether the distribution of a set of variables is equal or different from the distribution of another variable. Therefore if the hypothesis is rejected the distributions are different and if the hypothesis is not rejected it implies that the distributions are not different but not necessarily the same.

4.3.3 Kolmogorov-Smirnov test

The Kolmogorov test is similar to that of the Mann-Whiney U test, in the sense that it tests whether or not the distributions of two variables are equal.

4.4 Test Results

Independent sample median test:

The table represents the test for each variable across each building that includes the rent per square meter as well as the totaled amount per building category. It is to be noted the significance level was tested at a 95% confidence interval across each variable.

Net Rentals: H_0- The median of the Net rent are same across each building. The Null hypothesis was retained and thus implies that the medians are not much different from each other.

Operational Cost: H_0- The medians of the Operational cost are the same across the categories of the two buildings. The null hypothesis has been retained as a result it implies that the medians are not different from each other.

Gross R/m2- H_0- The medians of gross R/m2 are the same across the categories of buildings, as a result the null has been retained, which implies there are no significant evidence to suggest that there is a difference in the mean`s across buildings in relation to each buildings gross R/m^2

Operational R / m^2: H_0- The medians are the same across the categories of buildings. The null hypothesis is retained and therefore implies that the medians across the buildings in relation to each buildings operational cost per square meter do not suggest significant evidence for a difference between the two buildings operational costs.

Rent /m^2: H_0- The medians across the categories of buildings are the same across each building, the null hypothesis was rejected and therefore the medians across each category of the building are not equal.

Thus what was observed in each test is that the distributions are the same and the medians are the same therefore it suggested that the data from the two samples are very similar that one is not able to distinguish between the two distributions such that the variables exhibit the same type of behavior. Thus implying in the case of the set of variables that no significant difference can be found between green and conventional buildings.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The medians of Net Rent are the same across categories of Building Type.	Independent-Samples Median Test	.598	Retain the null hypothesis.
2	The distribution of Net Rent is the same across categories of Building Type.	Independent-Samples Mann-Whitney U Test	.952	Retain the null hypothesis.
3	The distribution of Net Rent is the same across categories of Building Type.	Independent-Samples Kolmogorov-Smirnov Test	.166	Retain the null hypothesis.
4	The distribution of Net Rent is the same across categories of Building Type.	Independent-Samples Kruskal-Wallis Test	.952	Retain the null hypothesis.
5	The medians of Op Cost are the same across categories of Building Type.	Independent-Samples Median Test	.000	Reject the null hypothesis.
6	The distribution of Op Cost is the same across categories of Building Type.	Independent-Samples Mann-Whitney U Test	.001	Reject the null hypothesis.
7	The distribution of Op Cost is the same across categories of Building Type.	Independent-Samples Kolmogorov-Smirnov Test	.000	Reject the null hypothesis.
8	The distribution of Op Cost is the same across categories of Building Type.	Independent-Samples Kruskal-Wallis Test	.001	Reject the null hypothesis.
9	The medians of Gross R/m2 are the same across categories of Building Type.	Independent-Samples Median Test	.103	Retain the null hypothesis.
10	The distribution of Gross R/m2 is the same across categories of Building Type.	Independent-Samples Mann-Whitney U Test	.000	Reject the null hypothesis.
11	The distribution of Gross R/m2 is the same across categories of Building Type.	Independent-Samples Kolmogorov-Smirnov Test	.000	Reject the null hypothesis.
12	The distribution of Gross R/m2 is the same across categories of Building Type.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
13	The medians of Ops R/m2 are the same across categories of Building Type.	Independent-Samples Median Test	.943	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
14	The distribution of Ops R/m2 is the same across categories of Building Type.	Independent-Samples Mann-Whitney U Test	.001	Reject the null hypothesis.
15	The distribution of Ops R/m2 is the same across categories of Building Type.	Independent-Samples Kolmogorov-Smirnov Test	.000	Reject the null hypothesis.
16	The distribution of Ops R/m2 is the same across categories of Building Type.	Independent-Samples Kruskal-Wallis Test	.001	Reject the null hypothesis.
17	The medians of Rent R/m2 are the same across categories of Building Type.	Independent-Samples Median Test	.003	Reject the null hypothesis.
18	The distribution of Rent R/m2 is the same across categories of Building Type.	Independent-Samples Mann-Whitney U Test	.001	Reject the null hypothesis.
19	The distribution of Rent R/m2 is the same across categories of Building Type.	Independent-Samples Kolmogorov-Smirnov Test	.000	Reject the null hypothesis.
20	The distribution of Rent R/m2 is the same across categories of Building Type.	Independent-Samples Kruskal-Wallis Test	.001	Reject the null hypothesis.
21	The medians of Rates R/m2 are the same across categories of Building Type.	Independent-Samples Median Test	.299	Retain the null hypothesis.
22	The distribution of Rates R/m2 is the same across categories of Building Type.	Independent-Samples Mann-Whitney U Test	.000	Reject the null hypothesis.
23	The distribution of Rates R/m2 is the same across categories of Building Type.	Independent-Samples Kolmogorov-Smirnov Test	.000	Reject the null hypothesis.
24	The distribution of Rates R/m2 is the same across categories of Building Type.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
25	The medians of Rates are the same across categories of Building Type.	Independent-Samples Median Test	.000	Reject the null hypothesis.
26	The distribution of Rates is the same across categories of Building Type.	Independent-Samples Mann-Whitney U Test	.002	Reject the null hypothesis.
27	The distribution of Rates is the same across categories of Building Type.	Independent-Samples Kolmogorov-Smirnov Test	.000	Reject the null hypothesis.
28	The distribution of Rates is the same across categories of Building Type.	Independent-Samples Kruskal-Wallis Test	.002	Reject the null hypothesis.
29	The medians of Gross are the same across categories of Building Type.	Independent-Samples Median Test	.007	Reject the null hypothesis.
30	The distribution of Gross is the same across categories of Building Type.	Independent-Samples Mann-Whitney U Test	.000	Reject the null hypothesis.
31	The distribution of Gross is the same across categories of Building Type.	Independent-Samples Kolmogorov-Smirnov Test	.000	Reject the null hypothesis.
32	The distribution of Gross is the same across categories of Building Type.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

4.4 Logistic regression.

By making use of a logistic regression, further analysis of the data revealed the following. Various models were considered and tested. Specific use was made of a technique called the Stepwise Regression. This process entails a stepwise approach to modeling where possible regressed variables are tested to see whether they are of significant "value" to the model. If their inclusion into the model makes no significant difference to the model's predictive ability, the variables are kept out of the model. Certain variables like Node, Firm Type, and JSE Industry classification were considered not only as regressor variables but also as subgroup variables. Within each of these subgroups, various models were also tested. All models tested are mentioned in the subsections, and more detail is provided only for those models where significant results were obtained

4.4.1 Model considerations and all possible variables

The first model considered was modelling the outcome (Green = "1", Conventional = "0") as a function of Node (used as a categorical variable), Firm Type (used as a categorical variable), JSE Industry Classification (used as a categorical variable), Net Rent per m^2, Operational cost per m^2, Rates per m^2, Gross rental per m^2 and Lease Period (converted to the duration of the lease in number of months). Stepwise regression was used with an inclusion significance level of 0:1 and a retention significance level of 0:1. The modeling dataset consists of 1417 observations with 1150 observations denoted as Conventional buildings and 267 observations denoted as Green buildings. The resulting model is questionable, and although many of the parameters are significantly different from 0, including JSE Industry Classification and Operational Cost as regressors in the model results in Quasi-Complete separation of the data points (subgroups become too homogeneous and contain either only Conventional buildings or Green buildings). The conclusion is that a model using all available regressor variables is neither feasible nor reliable.

4.4.2 Node, Lease period and Firm Type.

The stepwise approach suggests modeling the outcome as a function of two or three categorical variables Node and Firm Type, as well as Lease Period. The preliminary model does not exhibit a lack of fit, and many of the resulting parameter estimates are significantly different from 0. Further inspection of the obtained parameter estimates reveals that certain categorical values should be grouped together. To this end, the categorical variable Node is grouped into the following groups: Sandton and Other. The categorical variable Firm Type is grouped into the following two groups: International and Other.

The resulting model does not display a lack of fit, and all parameters are found to be significant at a 5% level of significance. The resulting model can be written as

$$l = -2.1356 + 0{:}5316\, I_{node\ Other} + 0{:}4542\, I_{Firm\ International} + 0{:}00571 L_{ease}$$

Where

$$I_{Node\ Other} = 1 \text{ if Node = Other}$$
$$I_{Node\ Other} = 0 \text{ if Node = Sandton}$$

And

$$I_{Firm\ International} = \text{1 if Firm = International}$$
$$I_{Firm\ international} = \text{0 otherwise}$$

To calculate the probability that a company is in a Green building, consider the example where a Multinational firm signs a 60-month lease in Sandton. The probability is calculated as follows:

$$I = -2.1356 + 0.5326I_{\text{node other}} + 0.4542\ I_{\text{firm international}} + 0.0057\ I_{\text{Lease}}$$
$$= -2,1356 + 0.5316(0) + 0.4542(0) + 0.00571(60)$$
$$= -1,793$$

Therefore other models considered:

$$= \frac{e^{i'}}{1+e}\hat{\imath}$$
$$\hat{P} = \frac{e^{-1.793}}{1+e^{-1.793}}$$
$$\hat{P} = 0.142705$$

Or alternatively, there is a 14:27% probability that said the firm is in a Green building. To measure model accuracy, the metric defined as Count R^2 is used. Count R^2 has defined as:

$$\text{Count } R^2 = \frac{\text{number of correct predictions}}{\text{total number of predictions}}$$

And the resulting model's accuracy is calculated at 81.16%. At face value this seems very good, however, it should be noted that only conventional buildings were correctly classified and all Green buildings were incorrectly classified.

Interpreting the odds ratios of the model yields the following: the odds for an international firms to lease a Green building is higher by a factor of 1.575 when compared to firms categorized in the "Other" class (when all other factors are kept equal); when comparing the Sandton node to the "Other" nodes, the odds for a firm in the "Other" nodes to lease a Green building is higher

by a factor of 1.702 when compared to firms in Sandton (when all other factors are kept equal). Specific output for the analysis can be found in the appendix.

4.5 Other models considered.

Various different combinations of models were tested, including modeling the outcome as a function of only Lease Period, only Net Rent per m^2, only Operational Costs per m^2, Rates per m^2, or Gross Rent per m^2. Provided in the following subsections is all relevant detail pertaining to these tests

4.5.1 Lease Period

Modeling the outcome only as a function of the Lease Period resulted in a model that didn't exhibit any lack of fit. Both the intercept and lease period parameter were found to be significantly different from 0 at a 5% level of significance. Reverting to the Count R^2 metric again shows high accuracy, but upon closer inspection, it is evident that only conventional buildings have been correctly classified.

4.5.2 Net Rent per square meter

Modeling the outcome only as a function of the Net Rent per m^2 results in an unreliable model where the parameter for Net Rent is found to be insignificant and the Goodness of the Fit test shows a lack of fit in the model. The conclusion is that the model obtained is unreliable and should not be considered further.

4.5.3 Operational cost square meter.

Modeling the outcome only as a function of the Operational Costs per m^2 results in an unreliable model where the parameter for Operational Costs is found to be insignificant and the Goodness of the Fit test shows a lack of fit in the model. The conclusion is that the model obtained is unreliable and should not be considered further.

4.5.4 Rates per square meter

Modeling the outcome only as a function of the Rates per m^2 results in an unreliable model where the parameter for Rates is found to be insignificant and the Goodness of the Fit test shows a lack of fit in the model. The conclusion is that the model obtained is unreliable and should not be considered further.

4.5.5 Gross rent per square meter.

Modeling the outcome only as a function of the Rates per m^2 results in an unreliable model where the parameter for Rates is found to be insignificant and the Goodness of the Fit test shows

a lack of fit in the model. The conclusion is that the model obtained is unreliable and should not be considered further.

4.5.6 Operational cost per square meter, Lease period and the interaction.

There is an expectation that Lease Period and Operational Costs are predictive of whether a company would lease a Green building. The perception is that long term Operational Costs are lower in Green buildings. To test whether the Lease Period, Operational Costs and their interactions are predictive in this sense, a Logistic Regression model was fit modeling the outcome as a function of Lease Period, Operational Cost, and their interaction. This model was found to exhibit a lack of fit, and all parameters except the intercept term were found to be insignificant. The conclusion is that the model obtained is unreliable and should not be considered further.

4.5.7 JSE industry classification.

The various subgroups of JSE Industry Classification were considered separately, Logistic Regression models were fit modeling the output as a function of Lease Period, and Operational Costs Respectively These two regressor variables were found to be the most predictive of the regressor variables. However, in none of the subgroups was a reliable model obtained. Most of the resulting models displayed a lack of fit, and the few that did not display a lack of fit had little predictive ability

4.5.8 Node

The various subgroups of Node were also considered separately and Logistic Regression models were fit, modeling the output as a function of Lease Period and Operational Costs respectively. Similarly, to the JSE Industry Classification subgroups, reliable models could not benefit, and many of the subgroups had too little data to derive accurate models.

4.6 Lack of predictive ability for Green buildings.

As mentioned earlier, Green buildings were incorrectly classified in all previous models where a lack of fit was not observed. This will occur when there is very little differentiation between the two subgroups (Conventional and Green buildings). Figure 2.1 provides a visual representation of the distribution of Lease Period for Conventional and Green buildings. There is a significant overlay of the two histograms, suggesting that Lease Period does not differentiate between Green buildings and Conventional Buildings.

4.7 Interview results.

In conjunction with the secondary data, primary interviews were conducted with industry professionals to verify the secondary data and establish what the current perception is, as well as the experience of office providers and users in the Gauteng office market, as well as the key drivers of office space.

It is noted that ten industry professionals were contacted but only seven professionals responded. Interviews were conducted over a period of three months, with seven industry professionals each representing a part of the property sector these include property managers, asset managers, leasing managers and banking professionals. A set of five standard questions were asked and further complimented by industry specific questions related to each professional's specific field in order to order to draw accurate knowledge from their diversified backgrounds.

The first question posed to each professional was to verify their industry experience and current role within their respective organizations. This question was used to verify credibility and reliance of professional's skill set.

It was established that each of the professionals interviewed have no less than 10 years' experience each in the property sector within their respective disciplines It was further established that each of the professionals interviewed have held and hold, senior, senior management and executive roles in their respective organizations that ranged from the banks, development managers and landlords.

Having established the level of experience and requesting the consent to proceed with the interview the following set of standard questions were posed.

The following question posed was to establish typical tenant profiles that are either housed or occupy green and or conventional space.

What are your typical tenant profile and your typical building portfolio?

The responses on the type of tenant profile overlapped across the six respondents yet the key underlying factor that was highlighted across the respondents was one the mandate to source the type of tenant and secondly the location that the building typically drew certain tenants.

Three of the six respondents have house government tenants, ranging from provincial, national and local government whilst the remaining three respondents housed large international corporations as well as domestic corporations.

The buildings typically owned by the landlords that house government are conventional B-grade buildings. Whereas Landlords that house corporations were found to possess P-grade and A-grade buildings found outside of the conventional C.B.D.

It is noted the 7th respondent was a professional from GBCSA and therefore only six respondent's responses were taken into consideration.

The following question investigated the knowledge and understanding of green buildings versus conventional buildings by tenants.

What is your understanding of green buildings?

Upon investigation to establish a common understanding of "green building" among tenants and landlords, it was established that green buildings decrease the use of energy and water. Not much more could be established as to why and how green buildings are used to improve building efficiency and why buildings should be rated or how they should be rated. With the exception of the green building professional, understanding and accurate knowledge could not be established.

The follow-up question was thus to establish how aware are landlords of their tenants understanding of green buildings versus conventional buildings.

How aware are your tenants of green buildings versus conventional buildings?

One of the key insights that was established regarding tenants and their knowledge of green buildings, 6 out 6 professionals interviewed had concluded that the awareness of green buildings in the Gauteng office space market is not at the level of required knowledge and standard that may inform the best green decisions in a property or property portfolio. As a result these ideas do not form part of most tenant requirements when tenants look for space.

One of the key factors established especially amongst government tenants is the need for convenience in terms of location, relative distances to economic hub as well tenants that share the same or similar industry (i.e. banks in the Sandton node) as well as transport nodes. As result highlighting the importance of location theory is still prevalent in the South African property market.

The next question was to then establish why developers build green or convert to green.

Why the trend to go "green"?

Two out of the six respondents when asked why they convert or go green one key reason was to establish a first mover principle the remaining respondents clarified their response by adding that the move was driven by tenant demands, tax incentives, and brand image. It was noted however that only one respondent's portfolio was actively changing and establishing green buildings.

The next question was to elaborate on reasoning of tenants occupying or seeking green buildings.

Which of your tenants prefer green buildings and why?

Four out of six respondents based on their interactions with tenants found that international tenants were more likely to want to occupy a green building versus a conventional building.

This was found especially where the building is to house their head office. The remaining two respondents didn't have the same type and caliber of tenants in their current portfolio and thus couldn't establish if any of their tenants had a specific reason or preference for green building. Tenants seeking green buildings was due to ESG principles that they needed to adhere to from a regulation and governance principle an example is Nedbank. Additional reasons in order of popularity was found to be brand image or branding then followed by the basic perceived drivers of energy efficiency and water saving. As result it is these reasons that incentivize developers to develop green buildings especially for Blue chip tenants.

Further questions,

All seven respondents acknowledged the need for better education by all property practioners with regards to green building as well as conventional building. As well as a need to distinguish between what has become best practice versus an outright green building.

Policy interventions by government to encourage more users of commercial space to use green buildings, thus increasing demand and further incentivizing suppliers. Also the possibility to establish green bonds or methods of funding that account for the risk that may be borne by both the tenant and developer.

Conclusion.

The ability to choose between green and conventional buildings currently (2016/2017) is perceived to follow a trend as opposed to established principles and empirical evidence in the South African market. Tenants with an international presence has shown a greater progression to establishing and choosing green buildings and accounting for sustainability initiatives. Unfortunately domestic or local tenants are finding a thin line between the costs versus the benefit decision in the factors why they should choose green, as many of their sites are considered in the short term as opposed to long term benefits. It is however noted as research and empirical analysis and data reveals itself in the south African context the "trend" is moving to a greater understanding and established financial benefits that are accounted for by both tenants and landlords alike,

Chapter 5

Conclusion and recommendations.

5.1 Introduction

Environmental sustainability, Green, and energy efficiency are the latest trends in the develop world that have extended itself across to the developing world. The question is, are these progressions that extend itself across generations that intend to reshape our world or mere trends that are once off revolutions to shake up the industry. Is there real financial benefit versus the academic theory that it portrays and who needs to adopt these trends? This study seeks to understand the academic literature as well as exams these trends in the context of the South African office space more specific to the Gauteng office market.

5.2 Summary of Findings

The primary research question that is addressed by this study is the following.
What are the significant factors financial and non- financial that are likely to influence tenant's choice between Green or Conventional buildings in the Gauteng office sector? Based on this primary research question the following hypothesis were formulated and tested in this study, each one acting as an ancillary question to address the primary research question.

Hypothesis 1: The medians of rentals, rentals per square meter, operating costs, operating costs per square meter is not different between green and conventional buildings.
The study found that the medians of rentals and operating cost per square meter across both green and conventional did not differ much if at all from each other. This therefore may imply that there are no significant difference in the average rental rates across Green or Conventional buildings such that it would suggest a different choice from one building versus the other.
The hypothesis shows no significant difference in the medians of rentals per square between Green and A-grade conventional buildings. One of the factors that may explain this is the possibility of excess supply in the Gauteng market and thus competitive comparative rates are presented by

landlords to tenants, this is in anticipation for landlords to try and secure tenants from other Landlords, thus no significant differences may be found. Similarly is the case with operational cost and gross rentals as these are factors of net rental. The components of operational cost such as water and electricity are also dependent on the type of tenant that occupies a building an example is audit firms where the majority of their professionals sit outside their offices and hence lower consumption may occur as opposed to a fully operational investment bank.

Tenants that demand space in the Sandton CBD, as opposed to outlying area's such as the Westrand, often pay the premium on a Conventional building merely because of its location, as opposed to the type of building so as to ensure long tern salability and letability of the building of owned.

Hypothesis 2: The distribution of rentals , rents per square meter, operating costs, operating costs per square meter is not different between green and conventional buildings. The second hypothesis tested the distribution of rentals and operating cost per square meter, the study found that no significant differences could be found across each of the two types of buildings.
Similarly to the first Hypothesis where no significant differences could be found the second hypothesis did not display any significant difference across each of the distributions of rentals, operating cost per square meter.

Hypothesis 3: Firm Type, JSE Industry Classification, Net Rent per m^2, Operational cost per m^2, Rates per m^2, Gross rental per m^2 and Lease Period influence the likelihood a firm will choose green over a conventional building. The hypothesis tested varying variables, Firm type, JSE industry classification and no significant differences were found that would suggest that a tenant would choose one building over the other.

5.3 Conclusion

As the study has examined the financial incentives and reasoning behind the choices of green buildings versus conventional buildings and the results have shown that there is not a significant reason for the either choice of green or conventional buildings specifically for conventional buildings that are P-or A-grade in quality.

The portfolio of buildings examined did reflect slight rental advantages when basic test regarding their hypothesis was completed but upon further investigation and probing of the data no significant financial incentives could be established that drew a tenant from one building to another. Interviews of professionals in the property sector were used to further investigate the reasons and were used to seek a greater understanding of the findings. The interviews verified that there are no significant financial factors that influence tenants and Landlords but rather that these factors were non-financial and many times attributed to increasing Brand awareness, outside pressures from parent companies that aren't domiciled in developing countries and lastly part of long-term strategy.

5.4 Recommendations for further study.

This study was limited to the Gauteng office market and thus does not cover offices in other large economic nodes in South Africa, thus further research may be recommended to include other economic hubs such as the Cape town as well as Durban that will enable a national study.

Other considerations for further study may be to do a comparative analysis of green and conventional buildings cost-benefit analysis using a portfolio review of all major property funds in South Africa.

Chapter 6

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Appendices

Annexure 1: Green building tools South Africa Building across A versus Gauteng.

Green Building Tool	**Number of buildings across SA**	**Number of buildings in Gauteng.**
Edge V1	0	0
Edge V2	0	0
Green star sustainable Precincts	1	0
Green Star SA – Custom Industrial	3	0
Green Star SA – Custom Mixed Use	7	1
Green Star SA- Existing Building Performance tool v1.	79	60
Green Star SA – Existing Building Performance tool Pilot.	31	13
Green Star – Existing Building Performance V1 Custom Tenant	1	0
Green Star SA – Interiors Tool	25	13
Green Star SA – Multi Unit Residential Pilot.	1	1
Green Star SA – Multi Unit Residential v1.	5	0
Green Star SA – Office v1	166	73
Green Star SA – Office v1 Shell &Core	1	0
Green Star SA – Office v1.1	14	8

Green Star SA –Public and Education Building Pilot	3	1
Green Star SA –Public and Education Building v1.	12	2
Green Star SA- Retail Centre v1.	3	3

SAS System results :

NODE (CONDENSED), FIRM TYPE (CONDENSED) AND LEASE PERIOD.

The SAS System

The LOGISTIC Procedure

Model Information	
Data Set	WORK.LEE_IMPORT3
Response Variable	Building_type_num
Number of Response Levels	2
Model	binary logit
Optimization Technique	Fisher's scoring

Number of Observations Read	1417
Number of Observations Used	1417

Response Profile		
Ordered Value	Building_type_num	Total Frequency
1	0	1150
2	1	267

Probability modeled is Building_type_num=1.

Class Level Information		
Class	Value	Design Variables
Node	OTHER	1
	SANDTON	0
Firm_type	INTERNATIONAL	1
	OTHER	0

Model Convergence Status
Convergence criterion (GCONV=1E-8) satisfied.

NODE (CONDENSED), FIRM TYPE (CONDENSED) AND LEASE PERIOD

Model Fit Statistics		
Criterion	Intercept Only	Intercept and Covariates
AIC	1373.466	1355.072
SC	1378.722	1376.097
-2 Log L	1371.466	1347.072

Testing Global Null Hypothesis: BETA=0			
Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	24.3938	3	<.0001
Score	24.6362	3	<.0001
Wald	24.1024	3	<.0001

Type 3 Analysis of Effects			
Effect	DF	Wald Chi-Square	Pr > ChiSq
Node	1	13.8957	0.0002
Firm_type	1	8.3233	0.0039
lease_period_num	1	7.4357	0.0064

Analysis of Maximum Likelihood Estimates						
Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	-2.1356	0.1726	153.0069	<.0001
Node	OTHER	1	0.5316	0.1426	13.8957	0.0002
Firm_type	INTERNATIONAL	1	0.4542	0.1574	8.3233	0.0039
lease_period_num		1	0.00571	0.00209	7.4357	0.0064

Odds Ratio Estimates			
Effect	Point Estimate	95% Wald Confidence Limits	
Node OTHER vs SANDTON	1.702	1.287	2.251
Firm_type INTERNATIONAL vs OTHER	1.575	1.157	2.144
lease_period_num	1.006	1.002	1.010

NODE (CONDENSED), FIRM TYPE (CONDENSED) AND LEASE PERIOD

Association of Predicted Probabilities and Observed Responses			
Percent Concordant	57.0	Somers' D	0.189
Percent Discordant	38.1	Gamma	0.198
Percent Tied	4.9	Tau-a	0.058
Pairs	307050	c	0.594

Partition for the Hosmer and Lemeshow Test					
		Building_type_num = 1		Building_type_num = 0	
Group	Total	Observed	Expected	Observed	Expected
1	211	23	26.17	188	184.83
2	70	11	9.31	59	60.69
3	174	24	24.83	150	149.17
4	143	26	22.98	117	120.02
5	112	17	21.13	95	90.87
6	170	42	33.67	128	136.33
7	145	26	29.97	119	115.03
8	146	33	32.15	113	113.85
9	140	43	34.76	97	105.24
10	106	22	32.03	84	73.97

Hosmer and Lemeshow Goodness-of-Fit Test		
Chi-Square	DF	Pr > ChiSq
12.6511	8	0.1244