



# **An Investigation into Green Office Buildings' Occupants' Self-Assessed Productivity Levels**

CON5010Z – Minor Dissertation

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## Abstract

Global warming is becoming a topic on everyone's mind as the world turns towards a sustainable way of living. In the property industry, people are looking for ways to encourage investors to move towards sustainable development. This requires some convincing as the increased costs of green buildings need to be justified, specifically looking at the financial returns for the investor. Green buildings are said to increase the productivity of their occupants but the difficulty in quantitatively measuring productivity has proven to be a stumbling block in this process. Various green buildings were identified, and their occupants interviewed to provide some answers on the impact of green certification in office buildings, specifically in Cape Town. Semi-structured interviews were conducted with occupants who worked in a building both prior to and during the implementation of green initiatives.

Difficulties in this measurement were noted and discussed throughout. As a result of the available responses and the guidance from the literature, it was decided that perceived productivity could be used as an acceptable form of productivity. It was therefore also necessary to include a section in the interview on personal stresses that the respondent may be experiencing that might also impact productivity.

Findings showed that whilst respondents were positive about the green environment and saw an increase in productivity, a few were unsure about whether these were linked, especially when other factors such as change in management had occurred. The overall feeling of respondents was better and healthier in the greener building, and all reported favourably on most green initiatives.

Future research on measurement tools can be investigated with a larger sample being interviewed. It will also be helpful to have further information into the respondents' backgrounds, position in the company and general feeling within the organisation that may affect productivity. The more knowledge the respondents have on the office, the larger the collection of reliable data. A greater range of green-starred buildings should be included as well as more than one respondent per building, to increase the sample for comparison.

## Acknowledgements

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## List of Abbreviations

CEO	Chief Executive Officer
CIDB	Construction Industry Development Board
CSR	Corporate Social Responsibility
GBCSA	Green Building Council South Africa
IEQ	Indoor Environment Quality
SABS	South Africa Bureau of Standards
SANS	South Africa National Standard
USA	United States of America
WCED	World Commission on Environment and Development
WGBC	World Green Building Council

# Chapter 1: Introduction

## 1.1 Introduction

Background on the topic will be broken down over several sections. Sustainable building will be defined, followed by a discussion of the office sector. This research will be limited to the office sector in Cape Town. This will link to indoor environment quality, an important aspect of an office and occupant productivity. The next section will look at green buildings and specifically at the Green Building Council South Africa (GBCSA), given the research is locally based. Following will be a discussion on the method of certification that the GBCSA uses. This will lead to productivity being defined which will be broken down into perceived productivity versus actual productivity and the method of measuring productivity.

The above background discussion has led to a research problem, question, proposition and aims being stated. This has allowed the researcher to set objectives, a methodology and identify limitations relating to the research topic and the current research environment. Figure 1.1 shows the breakdown of this chapter:

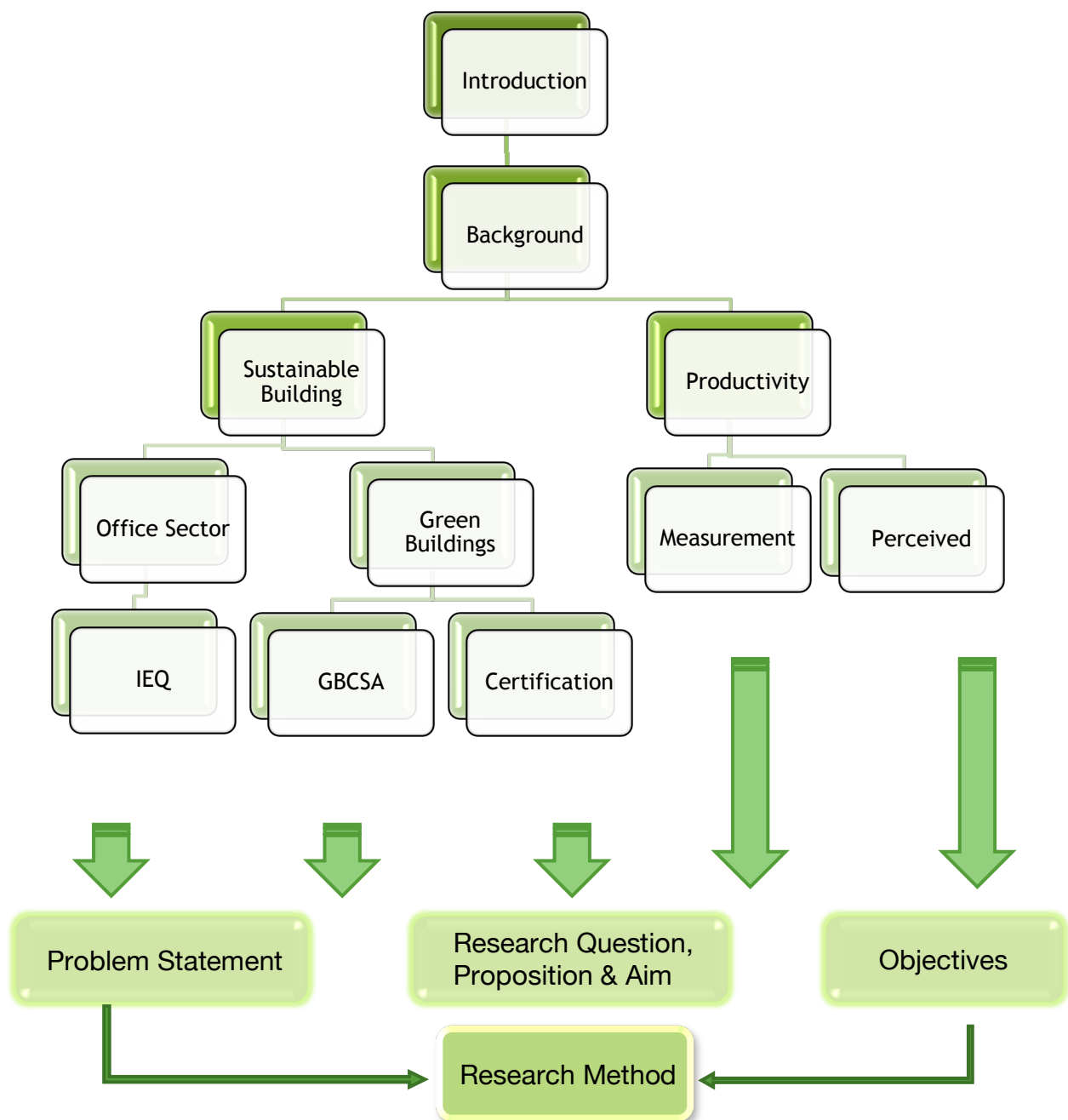


Figure 1.1: Chapter Outline

## 1.2 Background

### 1.2.1 Sustainable Development

The World Commission on Environment and Development (WCED) (1987) define sustainable development as one that “meets the needs of the persons without compromising the ability of future generations to meet their own needs”. This includes

conserving natural resources as well as economic and social balance within society and looking forward towards the developing potential in terms of education and enabling economic freedom (Feige, Wallbaum, Janser and Windlinger, 2013). du Plessis (2006) defined sustainable construction as a holistic process aiming to restore and maintain harmony between the natural and built environments and create settlements that affirm human dignity and encourage economic equity. A sustainable building will see reduced use of resources, specifically energy and water and the use of recycled materials in the construction of the building (Heerwagen, 2010). Consideration is also taken for the operation and renovation of the development and eventual demolition and recycling process (Feige *et al.*, 2013). A barrier to wider sustainable development is the additional investment cost associated with the process (Feige *et al.*, 2013; Sullivan, Baird and Donn, 2013). Higher planning and material costs of sustainable construction create the perception of a costly exercise with minimal immediate return (Feige *et al.*, 2013; Sullivan *et al.*, 2013; Dahiru, Dania and Adejoh, 2014). For the sake of the research, the sustainable development in this report will focus on the office sector.

### 1.2.2 Office Sector

This research will focus specifically on the Cape Town office sector. Productivity is determined by two aspects of the office, the layout and comfort (Haynes, 2007a). In terms of the office layout, open plan versus cellular offices are debated as well as matching the environment with the work processes (Haynes, 2007a; Miller, Pogue, Gough and Davis, 2009). Open plan offices are more cost effective, whilst matching office environments require more insight into how processes work within the office (Haynes, 2007a). The specific elements of an office need to be looked at, such as Indoor Environment Quality (IEQ), which contributes to productivity.

#### *Indoor Environment Quality*

Indoor Environment Quality (IEQ) refers to seven criteria as defined by Byrd and Rasheed (2016). These criteria include (1) internal air quality, (2) temperature, (3) humidity, (4) ventilation, (5) lighting, (6) acoustics and (7) ergonomic design and safety (Byrd and Rasheed, 2016). These aspects all have implications on the architectural form of a building (Singh, Syal, Grady and Korkmaz, 2010).

If the IEQ is not optimal, it can have a negative effect on the occupants' physical health caused by poor air quality, excess humidity or extreme temperatures coupled with poor ventilation (Miller *et al.*, 2009; Singh *et al.*, 2010). The result can be asthma, respiratory allergies and exacerbation (Singh *et al.*, 2010). Additionally, it can cause psychological health issues such as depression and stress caused by inadequate acoustics, lighting and ergonomic design (Singh *et al.*, 2010).

An enhanced IEQ and a better work environment will lead to a higher occupant satisfaction (Feige *et al.*, 2013; Sullivan *et al.*, 2013). This in turn can result in higher financial paybacks as it improves comfort levels and the performance of the buildings' users (Feige *et al.*, 2013). However, Byrd and Rasheed (2016) dispute this statement with their concern about whether, or not green accreditation that enhances the architecture and thereby increases comfort levels, actually causes an increase in productivity. IEQ can be enhanced through advanced ventilation and systems increasing air flow, the use of certain building materials and furnishings that have low toxicity, an increased use of daylight as opposed to electrical lighting or, in the case of electrical lighting, one that is high quality and energy efficient (Miller *et al.*, 2009; Heerwagen, 2010). Occupants should also be in greater contact with the natural environment, such as open views to the outdoors and indoor plants being situated in the building (Heerwagen, 2010). These elements all contribute to a greener building that qualifies for green certification (Heerwagen, 2010).

### 1.2.3 Green Buildings

When a building is certified as green it has incorporated design, construction and operational practices that significantly reduce or eliminate the negative impact of the development on the environment and society (WGBC, 2013a; GBCSA, 2018b; 2018c). These practices cause the building to be energy efficient and environmentally responsible as well as resulting in lower operating costs, higher efficiency levels, being future-proof and providing a higher rate of return (Construction Industry Development Board [CIDB], 2011; GBCSA, 2018b). Further, they increase wellness, healing and productivity levels (GBCSA, 2018c).

A developer invests in a green building with the end goal of reducing the impact on the Earth from constructing buildings and the materials used, reducing the impacts which arise during occupancy, reducing the impact of the structure at the end of its life, and creating a more desirable human experience (Gunnell, du Plessis and Gibberd, 2009). These goals go beyond minimising the negative effects of the development, to encouraging a positive impact, both within the building and on the outside environment (Van Wyk, 2008; Gunnell *et al.*, 2009).

The deterrent for any developer to invest in a green building, is the cost aspect. Much of the financial benefit only becomes evident in the long run, which is often beyond the investor's timeline (Feige *et al.*, 2013; WGBC, 2013a). Further to this point, with energy costs being low relative to other expenses, energy saving measures do not justify the cost (Feige *et al.*, 2013; Sullivan *et al.*, 2013). Investors require financial benefits such as capital and value premiums, reduced operating costs, reduced risk premiums or higher occupational rates (Feige *et al.*, 2013). Thus, in order to encourage the development of green buildings, investors would need to see the optimisation of labour costs or the increase of returns through their employees. To manage and encourage green buildings in South Africa, The Green Building Council was established in 2007 (GBCSA, 2018c).

### *The Green Building Council South Africa*

The Green Building Council's (GBCSA) main aim is to encourage the greening of South Africa's commercial property sector (GBCSA, 2018b). It is an independent, non-profit organisation that provides the training, tools, networks and knowledge to promote green building practices across South Africa (GBCSA, 2018b). The Council is one of over 95 members of the World Green Building Council (WGBC, 2013a; GBCSA, 2018c). They lead the transformation of the South Africa property industry, ensuring that buildings are designed, built and operated in an environmentally sustainable way (GBCSA, 2018c). For a building to be considered green, the GBCSA has designed an accreditation system.

### *Green Certification*

A green building is said to be certified when it reaches a certain number of credits under a rating system specific to the accreditation system of that country (Byrd and Rasheed, 2016). In South Africa, the development of green buildings is currently voluntary and varies

amongst developments (Gunnell *et al.*, 2009). The South Africa Bureau of Standards (SABS) developed the SANS 204 series of standards to provide a framework for energy-efficient buildings (Gunnell *et al.*, 2009). This created minimum requirements for buildings in comparison to the GBCSA rating that is for best practice (Gunnell *et al.*, 2009).

The GBCSA developed a Green Star South Africa rating system and is the official certification body in South Africa, and which is an adaptation of the Australian system (Gunnell *et al.*, 2009; GBCSA, 2018a). The GBCSA set standards and benchmarks to create an agreed-upon method of measuring and certification of green buildings (Gunnell *et al.*, 2009; GBCSA, 2018a). These rating systems provide a list of green measures used in the design, construction and management of a building to make it more sustainable (GBCSA, 2018a). For a building to be rated, the owners submit documentation to the GBCSA whereafter a building can be awarded a 4- for best practice, 5- for South African Excellence or 6-star rating for World Leadership (CIDB, 2011; GBCSA, 2018a). The rating is based on points allocated to the green measures that have been implemented in the building (GBCSA, 2018a). As seen in the United States of America and Australia, implementing a Green Rating System creates a unique selling point and is vital to marketing the office as a premium space (Gunnell *et al.*, 2009). Green certification and its hypothesised benefits such as greater productivity and financial gains have become the central marketing tool used by developers of sustainable buildings (Byrd and Rasheed, 2016).

### 1.2.4 Productivity

Productivity is the ratio of output to input (Feige *et al.*, 2013; Sullivan *et al.*, 2013). In addition to this definition, Sullivan *et al.* (2013) states it is the increase of output, reduction of input - usually the costs or a combination of the two. Productivity is shown through a number of indicators such as health and well-being, overtime and interruptions to work but it excludes factors that affect productivity from outside of the work place, such as social factors (Clements-Croome, 2003; Byrd and Rasheed, 2016). This is where a problem arises as it is difficult to determine which factors are affecting the occupants, whether it is internal green factors, or external social factors such as loss of sleep, personal stress, or relationships (Byrd and Rasheed, 2016; Clements-Croome, 2016). Haynes (2007a); Miller *et al.* (2009) specifically define office productivity under seven distinct components, namely: (1)

distraction, (2) environmental service, (3) office layout, (4) interaction, (5) designated areas, (6) comfort and (7) informal interaction points. Each of these factors have an influences on how occupants perceive their own productivity levels and contribute to the measurement of productivity (Miller *et al.*, 2009).

### *Perceived Productivity*

When measures of productivity are limited, and actual productivity is difficult to measure accurately, it may be necessary to look at perceived productivity. However, this process has its advantages and disadvantages. Perceived productivity removes the need to tailor the questionnaire to suit different employees in different types of buildings as it asks people to rate their productivity, making it subjective (Haynes, 2007a; Sullivan *et al.*, 2013). There is evidence that states perceived productivity may reflect actual productivity, as people are aware of how the environment affects them and thus their perceived productivity influences a person's actual productivity (Sullivan *et al.*, 2013).

On the negative side of this measure, people tend to overestimate their productivity levels, causing their judgement accuracy to be questionable. Byrd and Rasheed (2016) doubt the validity of this indicator as a true reflection of actual productivity. Haynes (2008a) states in order that for perceived productivity to be a valid measure, there needs to be more than one question on productivity included in the questionnaire so that participants can create a benchmark for themselves (Byrd and Rasheed, 2016). It is therefore necessary for the results of such a measure to be analysed and interpreted carefully as uncertainty exists (Sullivan *et al.*, 2013).

### *Measuring Productivity*

Based on the definition of productivity, traditional methods of measuring include input and output quantities used in the production process (Byrd and Rasheed, 2016). Sullivan *et al.* (2013) measure productivity further and look at factors such as perceived productivity, cognitive performance tests, absenteeism, mood and turnover. These are mostly subjective measurements as it has proven to be impractical to measure objectively in this case (Sullivan *et al.*, 2013). Although these measures may be limited and only indicate the effects on the overall productivity, it can be a sufficient measurement here (Sullivan *et al.*, 2013). It

should be noted that these factors are not always available to measure. Whilst one can measure inputs by looking at time and resources, it is more difficult to measure outputs objectively (Sullivan *et al.*, 2013). Furthermore, the lack of standardisation in these measures, prevents the researcher from making comparisons across employee types, especially in the modern office (Haynes, 2008a; Sullivan *et al.*, 2013). Koopmans, Benaards, Hildebrandt, Schaufeli, de Vet Henrica and van der Beek (2011) therefore suggest that the researcher also looks at factors that contribute to and have an effect on productivity.

The GBCSA states that improved IEQ from factors such as increased ventilation, temperature and lighting control, the use of natural light and the absence of toxic materials result in improved health, comfort, and well-being of building occupants (GBCSA, 2018b). This has shown an increase in productivity which is important to any business when looking to increase their profitability (GBCSA, 2018b). The GBCSA state that studies have shown an improvement in productivity of up to a 20%, which in their opinion justifies the cost of creating a green space (GBCSA, 2018b). Sullivan *et al.* (2013) support this statement as shown in Figure 1.2. This is still being debated by Byrd and Rasheed (2016). This leads the researcher to the proceeding problem statement.

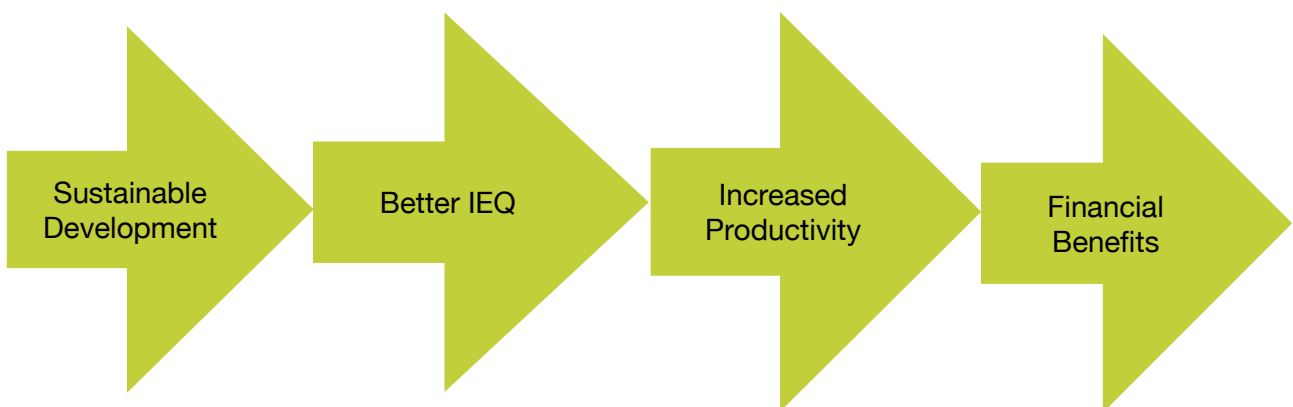


Figure 1.2: Sullivan *et al.* (2013) and (GBCSA, 2018b)'s opinion about the results of sustainable property.

### 1.3 Problem Statement

The following problem statement was formulated for the study:

*The relationship between green office buildings and the occupants' levels of productivity is unknown.*

## 1.4 Research Question

The research question to be answered in this study is:

*What is the relationship between green office buildings and the occupants' levels of productivity?*

## 1.5 Research Proposition

The research proposition to be examined is:

*A positive relationship exists between green office buildings and the occupants' levels of productivity.*

## 1.6 Aim

The aim of this study is:

*To establish whether a relationship exists between green office buildings and the occupants' levels of productivity.*

## 1.7 Objectives

As a result of the above, the following objectives were identified:

- i. To determine the most common green features in office buildings.
- ii. To determine how productivity is measured in an office building.
- iii. To determine occupants' perceptions on the effects of green features on their IEQ in office buildings.
- iv. To assess the occupants of green office building's perception of green features on their productivity.
- v. To determine the effect of the implementation of green features on occupants of office buildings.

## 1.8 Methodology

The following research approach was applied for this study:

- i. A literature review of research similar to this study, including past research, gaps in the research and possible future research of the topic. These topics include sustainable development, green buildings, indoor environment quality, productivity, and the link between green buildings and productivity. These topics will also be broken down into further sections.
- ii. A combination of structured questions in the beginning, but mostly open-ended questions with occupants of green office buildings.
- iii. Multiple case study methodology - Thematic Analysis to determine the similar and dissimilar themes in the data.
- iv. Detailed interpretation and discussion of the findings.
- v. Conclusions and recommendations for future research presented.

Sullivan *et al.* (2013) suggest a questionnaire as the best method for assessing environmental conditions and their effects on people. The questionnaires should be answered by occupants of green office buildings to see how they are responding to the building and whether it is serving their needs (Haynes, 2007a; Sullivan *et al.*, 2013). This also allows the researcher to determine whether there are any external factors affecting the occupants (Sullivan *et al.*, 2013). This questionnaire will be semi-structured, consist of a few structured questions and more open-ended questions to avoid confining respondents' answers.

## 1.9 Limitations

- i. Lack of a clear definition or standard measure of office productivity (Sullivan *et al.*, 2013).
- ii. Productivity is difficult to measure which leads to perceived productivity being used, which is not always considered a valid indicator of actual productivity (Byrd and Rasheed, 2016).
- iii. The above limitation, coupled with the structure of the interviews, could have led to bias.

- iv. Only green office buildings in Cape Town are included in the research, limiting both sector and geographical region.
- v. Only 4-Star green buildings were approached for interviews, giving a limited sample.

## 1.10 Structure of Report

The remaining sections of the research report are structured as follows:

### *Chapter 2*

Chapter 2 includes a literature review of the research topic, a further expansion on the background discussed in Chapter 1. The topics include sustainable building, which extends to green buildings, indoor environment quality and productivity. Productivity includes sub-sections such as measuring productivity and what relationship exists between productivity and green buildings. This comprehensive overview of the literature leads to identifying the research questions and objectives.

### *Chapter 3*

Chapter 3 discusses the research methodology used in this research report. Similar past research as well as the circumstances surrounding the research, such as availability of information, reliability of responses and length of the study determined the method selected. This has been carefully selected to produce the most reliable and relevant results.

### *Chapter 4*

Chapter 4 presents the findings of the research conducted through questionnaires with occupants of green office buildings. An analysis of these findings aimed to address the research objectives and answer the research question.

### *Chapter 5*

Chapter 5 uses the analysis and findings to support or refute the research proposition. Findings are analysed within the context of the literature. This leads to a conclusion of the report and whether a relationship exists between green office buildings and the occupants' productivity levels.

## 1.11 Chapter Summary

This chapter has given an overview of sustainable development, green buildings and productivity. The research problem, question, proposition, aims and objectives have been identified. The research methodology and limitations have also been briefly discussed.

# Chapter 2: Literature Review

## 2.1 Introduction

This chapter aims to provide a critical analysis of the literature surrounding green buildings and their effect on the occupants' productivity levels in a logical format as represented by Figure 2.1.

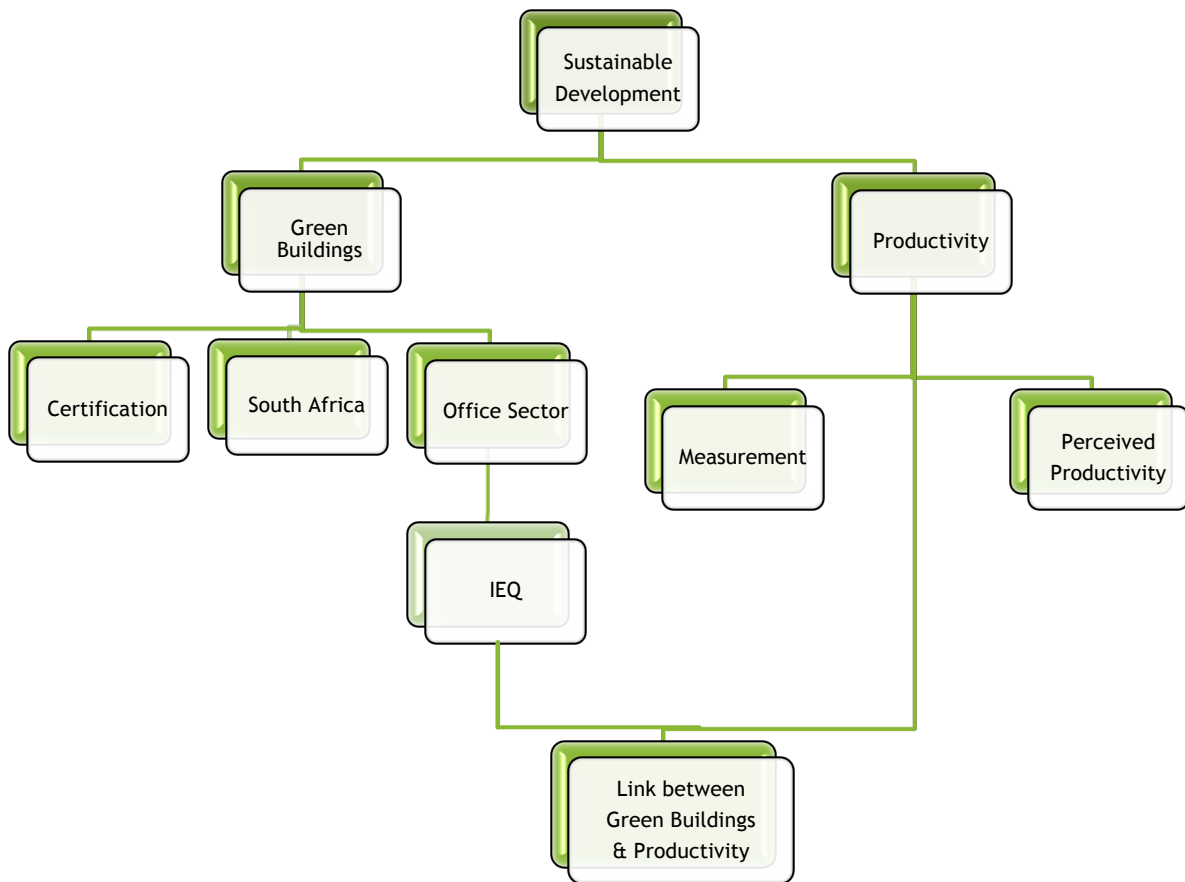


Figure 2.1: Literature Review Flowchart

The views of the following discussion vary between different stakeholders and will be discussed from all points of view. In the case of an owner-occupier of a building, they will focus critically on the productivity spin-offs from a green building in terms of, inter alia, a motivated workforce, a reduction in sick leave, and the efficiency in the workplace. For a

listed property fund or a property investor, the focus will be on the rental income from tenants in a particular building.

## 2.2 Sustainable Development

There is a growing trend worldwide, to become more sustainable in both peoples' personal lives, and in peoples' workplaces (Feige *et al.*, 2013; WGBC, 2013b). The recent high-profile public protests across the world, for example the Extinction Rebellion Movement across Europe and the United Kingdom, have further highlighted a greater public awareness of the need to deal with climate change and the consequences on the environment (Feige *et al.*, 2013). As the world becomes more aware of climate change, businesses and investors are encouraged to move towards sustainable development (Revkin, 2019). This change however does not come without a cost. Sustainable development incurs higher costs than a regular development and this cost needs to be justified (Feige *et al.*, 2013). Investors base their investment decisions on financial gains, usually placing less consideration on environmental and social reasons (Feige *et al.*, 2013). The ultimate decision is made based on budgets and schedules and investors rarely look at the long-term knock-on effects (Ries, Bilec, Gokhan and Needy, 2006). Investors need the motivation to invest in a venture that may seem unnecessarily costly. Businesses are likely to be pressurised to show what sustainable initiatives they have within their mission statements. It will also encourage the government to implement pre-determined Sustainable Development and Green Initiatives criteria (GBCSA, 2006). The aim would be for this to ultimately be the catalyst to expediting the roll out of sustainable development into the future.

Sustainable development, as defined by the (WCED, 1987), also known as the Brundtland Report, is a "development that meets the needs of the present without compromising the ability of the future generations to meet their own needs". This definition is centred around people and focuses on three main quality of life objectives, also described as the dimensions of sustainability – social, environmental and economic (Othman, 2009). These comprise social progress that addresses the needs of all people, the effective protection of the environment and the cautious use of natural resources, and the maintenance of stable levels of economic growth and development (DETR, 2000; Othman, 2009). The origin of sustainable development is the reaction to a global environment crisis, where the construction process plays a significant role in climate change, pollution, resource

depletion and energy consumption on both a local and global scale (Othman, 2009). Sustainable development is a broader term than that of green buildings by including the economic, social and environmental factors into the ergonomic design process (Thatcher and Milner, 2014).

Sustainable design aims to reduce the negative environmental impacts throughout the life cycle of the building (Othman, 2009). The balance needs to be found between environmental considerations, societal requirements and economic considerations (Hui, 2002; Othman, 2009). It is often found that whilst focusing on reducing the negative impact on the environment through sustainable design, the economic factors are not taken into consideration, incurring substantial costs for the investor. Further to this goal, is to improve the internal environment quality of a building (Abbaszadeh, Zagreus, Lehrer and Huizenga, 2006). The definition also includes a forward-looking component, by developing potential in terms of education and economic freedom (Feige *et al.*, 2013). However, it requires an additional investment cost, an investor deterrent which is evident in the current slow adoption and low share of sustainable development (Feige *et al.*, 2013).

These increased costs result from more complex planning, and the costly materials required (Feige *et al.*, 2013). Sullivan *et al.* (2013) justify this expense by looking at the costs of construction and operation being fairly low relative to the lifespan of the building. With that being said, for an investor, the break-even point can be too far in the future and outside of the investor's timeline (Feige *et al.*, 2013). Even with the subsequent savings on energy costs that a building incurs, investors are not likely to justify the initial investment costs associated with sustainable development (Feige *et al.*, 2013). As technology progresses, these costs may become less substantial in the future, and contribute towards more of an achievable investment. These technological advances may also allow existing buildings to adopt sustainable measures, without investors incurring the cost of a new building. This will depend on the timeline of these advances and the overall perception of their effectiveness.

Heerwagen (2010) believes sustainable development may become a strategic asset in the future. This is already being seen when policy-makers, institutional investors and corporations are more regularly considering buildings as assets for achieving energy

efficiency, carbon abatement, and corporate social responsibility (Chegut, Eichholtz and Kok, 2013). Sustainable design increases the awareness of the importance of saving the environment and encouraging the adoption and application of sustainability concepts (Othman, 2009). It further reduces the undesirable environmental effect of buildings by encouraging the use of durable, environmentally-friendly, non-toxic materials and equipment (Othman, 2009). The corporate social responsibility of sustainable design encourages design and construction professionals to be proactive in taking responsibility for the environment within their own supply chains (Othman, 2009). Thus, by identifying this competitive advantage, investors may be encouraged to focus on sustainable development.

The financial benefits in place for sustainable development such as tax deductions and public subsidies are only applicable to private individuals, looking at building family homes (Feige *et al.*, 2013). In order to attract public investors into the commercial market, there need to be other financial benefits such as capital and rental value premiums, reduced operational costs, higher occupancy rates, or a reduced risk premium (Feige *et al.*, 2013). Additionally, when more human benefits are identified, specifically relating to productivity gains which have been identified as an effect of improved IEQ, sustainable development will be preferred (Heerwagen, 2010). Introducing policies that benefit the investor and occupant company is a key factor to be considered in South Africa, should there be a desire to encourage sustainable development.

### 2.2.1 South African Context

Corporate social responsibility (CSR) in South Africa with regards to green buildings has shown an increasing demand for integrating the environmental, social and economic considerations into the design decision-making process (Othman, 2009). This has encouraged design and construction professionals to create value-added and innovative solutions towards producing a sustainable built environment in South Africa (Othman, 2009). To encourage this process and create awareness around CSR of sustainable design, it is important to educate both the public and private sectors about a sustainable environment and its related benefits (Othman, 2009). As part of the education, the establishment of the appropriate rules and regulations is important to urge current

generations to use natural resources sparingly to enable future generations to continue building a sustainable environment (Othman, 2009).

## 2.3 Green Buildings

Kato, Too and Rask (2009) defines green buildings as ones with an ecologically sustainable focus. The buildings and their sites are said to use energy, water and materials with increased efficiency and a less significant building impact on its inhabitants and the environment. This is achieved through better design, construction, operation, maintenance and removal, throughout the building's complete life cycle (Kato *et al.*, 2009). Green buildings should be built with the aim of improving the well-being of natural systems and the well-being of the building's occupants (Thatcher and Milner, 2014). A green building is achieved by efficiently using resources, ensuring occupant health with an increased productivity and ensuring less of an impact of the outputs on the environment (Thatcher and Milner, 2014).

Buildings, and specifically green buildings, add value to an organisation's core business (Clements-Croome, 2003). Organisations look at developing green buildings as a result of tighter government regulations, market pressure stemming from tenant demand, corporate responsibility, positive brand opportunities and financial savings through more efficient asset management (Clements-Croome, 2003; GBCSA, 2006; Nurick and Thatcher, 2021).

(Clements-Croome, 2003) points out that many decisions in the design, construction and facilities management processes are made with the capital cost in mind. This often leads to low cost, and thus low quality buildings (Clements-Croome, 2003). Investment decisions are made with financial reasons in mind, often ignoring environmental and social considerations (Feige *et al.*, 2013). Over the lifetime of the building, the cost of employment proves to be the greatest expense (Clements-Croome, 2003; Nurick and Thatcher, 2021). Therefore, it is vital for the focus to create the greatest return on this expense and thus to ensure productivity is at its highest.

MacNaughton, Spengler, Vallarino, Santanam, Satish and Allen (2016) report that building design and operation have changed in response to social and economic pressures with

unexpected impacts to human health and well-being over the past century. Green buildings are expected to have internal environments that are more comfortable and encourage higher levels of productivity (Mallawaarachchi, De Silva and Rameezdeen, 2016). Occupants in green buildings have reported significantly lower carbon dioxide levels and improved IEQ, compared to a conventional building (MacNaughton *et al.*, 2016).

In general, workers are more satisfied and perform better when presented with a new or recently improved work environment (Schwede, Davies and Purdey, 2008). It is thus important for green buildings to both perform well and to be perceived as superior to address both the psychological and physiological aspects (MacNaughton *et al.*, 2016). Occupant ratings are higher in green buildings regarding environmental satisfaction (Newsham, Birt, Arsenault, Thompson, Veitch, Mancini, Galasiu, Gover, Macdonald and Burns, 2013). These ratings are supported by temperature levels and ventilation, aesthetic appearance, access to the view outside and size of the workspace (Newsham *et al.*, 2013). Coupled with the higher ratings, lower frequency of visual and physical discomfort symptoms and a better mood and quality of sleep at night (Newsham *et al.*, 2013). While it was reported that both green and non-green buildings present acceptable indoor conditions, green buildings presented a much higher quality internal environment (Newsham *et al.*, 2013).

Superior performance of a green building is positive for society as it is increasingly facilitating their developments (Newsham *et al.*, 2013). It is important to note that green elements cannot simply be implemented at random, to create a productive environment. (Clements-Croome, 2003) emphasises that for significant improvements to be seen in productivity, the building must be properly designed and managed. Innovative workplaces can improve the performance of the firm by attracting and retaining more innovative workers (Schwede *et al.*, 2008). It is important to invest in the quality of the environment and facilities that enhance the productivity of the workers (Schwede *et al.*, 2008). The result of a lack in planning has been identified by Newsham *et al.* (2013) and Miller *et al.* (2009) where they report that not all green buildings may be showing the energy and internal environment performance that is expected by owners, which may deter the uptake of green buildings (Newsham *et al.*, 2013). Due to construction materials such as glue and paint that are being used, the new or newly refurbished green buildings are not always healthier (Miller

*et al.*, 2009). Kato *et al.* (2009) expands on the objections towards green buildings by identifying the dissatisfaction amongst respondents and the resulting scepticism regarding occupier benefits. Respondents reported noise and privacy issues associated with open spaces as there is an increase in the number of occupants in a single open space, making it difficult to have private phone calls or avoid the noise resulting from conversations between occupants (Kato *et al.*, 2009). Power-saving initiatives caused disappointment in the lighting, air conditioning levels and distances between appliances such as computer and printer (Kato *et al.*, 2009). It is thought that this can decrease financial performance and affect the ability to attract talent (Kato *et al.*, 2009). The financial aspect is the most important component of the building for investors to consider (Clements-Croome, 2003). Kato *et al.* (2009) put these ideas and possible misconceptions down on the perceived higher construction costs, lack of user education, sufficient and credible supporting evidence, and unrecognised eco-labelling.

In the argument for green buildings, Ries *et al.* (2006) discusses the savings due to the gains in employee productivity, the reduction in health and safety costs, and savings from energy, maintenance and operational costs (Nurick and Thatcher, 2021). The externalities that arise from green buildings include positive effects on the surrounding communities (Chegut *et al.*, 2013). This consists of reducing energy consumption, waste and carbon emissions (Chegut *et al.*, 2013).

Following this is a positive price impact due to gentrification, which improves the surrounding neighbourhoods (Chegut *et al.*, 2013). Thatcher and Milner (2014); Laughton and Thatcher (2019) list the ergonomics that are needed to improve a green building design. They are (1) the ergonomics of green building construction, (2) the ergonomics of building maintenance, (3) the ergonomic factors related to the demolition of the building and, (4) the design for sustainable work that ensures comfort and understanding for the occupants of the building, which ultimately influences the occupants' behaviour (Laughton and Thatcher, 2019). These positive economic externalities help to alleviate the negative effects that buildings impose on the environment (Chegut *et al.*, 2013). This may also encourage an increase in business if the public is more inclined to work with a company that shows green initiatives.

From an investor's perspective, a building with the abovementioned benefits is able to achieve higher rentals with occupiers realising the true returns and lower costs from a more efficient office space (Kato *et al.*, 2009; WGBC, 2013b). This in turn increases demand for green buildings. The simple economics of supply and demand will come into play here, with a further positive impact on the rental rates and escalations achievable in these buildings as opposed to a normal building (WGBC, 2013b). It will also encourage occupiers to adopt green practices within their workspace and possibly encourage longer leases on the buildings (WGBC, 2013b). Additionally, it should create barriers to entry for buildings that do not comply with the green standard set and therefore a threshold for successful tender processes will be set by the market (WGBC, 2013b).

Kato *et al.* (2009) reports that green buildings exceed the projected environmental benefits by also increasing occupant productivity and satisfaction. This is validated by many authors such as Haynes (2008a); Singh *et al.* (2010); Feige *et al.* (2013); Byrd and Rasheed (2016); Thatcher and Milner (2014); Mulville, Callaghan and Isaac (2016) and MacNaughton *et al.* (2016). Although there will be stronger psychological benefits than physical benefits, these complementary benefits allow firms with green buildings to hold a competitive advantage over rival firms (Kato *et al.*, 2009). The cost of employment for the occupants is greater than the cost of construction and operation of the building over its lifetime (Clements-Croome, 2003; Sullivan *et al.*, 2013). The higher value placed on workers makes it fundamental to focus on creating a productive environment for occupants (Sullivan *et al.*, 2013). Characteristics of green buildings are said to serve occupants' expectations of obtaining a comfortable workspace (Leaman and Bordass, 2007; Mallawaarachchi *et al.*, 2016; Chadburn, Smith and Milan, 2017). A small effect on productivity holds great value for firms and investors (Sullivan *et al.*, 2013). Occupants who are satisfied with the overall quality of their working environment are assumed to be more productive (Leaman and Bordass, 2007; Mallawaarachchi *et al.*, 2016).

Additionally for investors, tenants are willing to pay higher rents for buildings that can enhance productivity (Miller *et al.*, 2009). Chegut *et al.* (2013) further discusses the tenant's motivation towards green buildings due to the enhanced reputational benefits and CSR mandates, in addition to productivity. CEOs (Chief Executive Officers) use buildings as a way to achieve corporate strategic goals, leading to the market growth of green buildings

(Heerwagen, 2010). The strategic benefits of green buildings include a reduction in the use of resources, the use of recycled materials, the use of renewable resources and pollution prevention and waste reductions (Heerwagen, 2010). Thus green buildings can provide both a cost reduction benefit and a value-added benefit, however emphasis is placed on the costs (Heerwagen, 2010).

### 2.2.1 Certification

Investors are motivated by the idea of green building certification as the focus on IEQ has a greater financial impact through employee wellbeing and possibly increase productivity (Nurick and Thatcher, 2021). Green building rating systems provide credits for energy-efficient design and steps taken to reduce the negative effects on the environment, such as allowing daylight throughout the office with low partitions or hard floors and ceilings to improve the quality of the air in the offices (Newsham *et al.*, 2013; Driza and Park, 2014). They award credits for building lifecycle elements such as the choice of the building site and ecology of that site, choice of materials, design innovations that minimise resource use and emissions (Thatcher and Milner, 2014). The purpose of the certification of green buildings is to achieve green certified buildings that are environmentally friendly, energy saving and healthy (Wei, Ramalho and Mandin, 2015; Mallawaarachchi *et al.*, 2016). In essence, it focuses on reducing the building's ecological mark footprint (Driza and Park, 2014).

Certification facilitates the process of intermediation between investors, building developers and tenants in the context of what makes a quality or efficient building (Chegut *et al.*, 2013). It helps these stakeholders to invest in the right buildings (Chegut *et al.*, 2013). It is a vital rating tool that recognises a comfortable, healthy and productive work environment, known as the indoor environmental quality (IEQ) (Thatcher and Milner, 2014). A positive relationship has been seen between environmental certification and the building's financial outcome (Chegut *et al.*, 2013). There have been significantly positive effects on the selling price and market rentals following the certification of office buildings (Chegut *et al.*, 2013). Having a certified green building has positive green knock-on effects as well as bringing awareness to occupants of the building (Kato *et al.*, 2009). Additionally, it has been reported that a correlation exists between certification and user well-being (Driza and Park, 2014). Certification encourages building designers to incorporate green

elements into their design which will improve occupant well-being and productivity (Thatcher and Milner, 2014).

### 2.2.2 Green Buildings in South Africa

In 2011, regulations were introduced in the construction industry in South Africa that required all new buildings to use solar water heaters, heat pumps or similar technologies (Rijswijck, 2011). Walls, ceilings and windows have to meet minimum requirements in insulation, to both minimise heating in winter and cooling in summer as well as the building is fitted with energy efficient heating, air-conditioning and mechanical ventilation systems (Rijswijck, 2011). Any higher standard remains voluntary. As a result, the growth of green buildings in South Africa surpasses that of established sustainability building regions such as Europe, the United States, Australia, the United Arab Emirates, Brazil and Singapore (Export.gov, 2018). Modise (2019) notes the success in South Africa in 2018 with 61% of building projects being green as opposed to the global average sitting on 37%. In a survey done by Export.gov (2018), by the end of 2018 60% of firms reported they had plans in the future to build green buildings, and 58% of firms confirming plans for retrofits. Despite the economic instability in South Africa, the adoption of green measures has not slowed down.

Groenendaal (2019) however states that the current building standards in South Africa are not in line with the goals to complete decarbonisation and achieve Net-Zero Energy Standards by 2030 which needs to be primarily driven by a policy change. Groenendaal (2019) also states that South Africa has been more focused on their socio-economic issues than on the environmental issues, contrary to what was reported by Export.gov (2018). However in 2019, the Minister of Energy in South Africa has implemented a new law requiring public and private building owners to measure and report their energy use (Groenendaal, 2019).

The above evidence shows that the South African government and the private sector both recognise the need for energy-efficient building systems and practices, all of which require extensive international, technical and financial support (Export.gov, 2018). South Africa's commitment to green building is evident in its involvement in the WGBC of which its expertise and guidance were used in establishing the GBCSA (Export.gov, 2018). Currently

in South Africa, skilled professionals and manufacturers in the green building industry are limited but with the increased consumer and market awareness, the diverse range of green building materials and products are continuously growing (Export.gov, 2018). With this comes exponential growth in terms of job creation and environmental benefits. It is projected that in the long run, South Africa should have sufficient resources to supply many green building materials by partnering with the relevant international companies (Export.gov, 2018).

Currently in South Africa, the drive exists for businesses to operate in a more socially and environmentally responsible way but, more importantly, financial incentives are being realised (Export.gov, 2018). Businesses are always looking for ways to lower their occupation costs and green buildings allow them to lower the cost of electricity and water, expenses which have been increasing over the past few years in South Africa (Export.gov, 2018). This explains that developers in South Africa are primarily focused on the bottom line with conserving the environment coming in thereafter (Export.gov, 2018).

## 2.3 Office Sector

Office workers spend up to 90% of their day in their office environment and their salaries make up the majority of the overall office building expenditure (Ries *et al.*, 2006; Mallawaarachchi *et al.*, 2016). It is therefore vital to ensure these occupants have the optimal office environment to perform to the best of their ability. The office environment can be described in its physical terms, the layout of the office and the comfort of its occupants (Haynes, 2007a). The layout can be discussed as open plan versus cellular offices or matching the environment to the work processes (Haynes, 2007a). Open plan is said to lower costs, whilst matching the environment to work processes requires a greater understanding of what employees are doing, which can be an advantage in the long run (Haynes, 2007a). If an office is going to allow for knowledge creation and knowledge transfer, then they need to enable collaborative work and individual work to coexist without causing any conflict between the two (Haynes, 2007a). This balance can be achieved by designing an office that takes the impact and quantification of the behavioural environment into consideration, on the office and occupiers' productivity (Haynes, 2007c). The office environment is more than just a physical environment and a more positive social

environment has been associated with greater perceived support for a creative workplace with environmental distraction reducing creativity (Haynes, 2007d). The consensus from Oseland (1999); Leaman and Bordass (2007); (Clements-Croome, 2003) and Haynes (2007c) is that the office environment has an effect on occupiers' productivity, but this is not universally accepted.

Clements-Croome (2003) reports that the most significant factors affecting productivity are crowded workspaces, thermal problems, sick building syndrome factors and stuffiness. However, conflicting opinions have arisen between the benefits created and the inconveniences caused, for example an open space and the need for privacy and quietness for concentration and confidential tasks (Abbaszadeh *et al.*, 2006). A high-performing workplace is defined by three measures, according to Haynes (2007b), namely: (1) employee satisfaction: people like their environment, (2) productivity: people can be at their most productive in their environment and, (3) employee retention: people stay with the organisation in part because they like their environment. Furthermore, he states that the two major causes of loss of productivity in offices are (1) distractions and (2) the mismatch between occupier's work activities and the work environment provided (Haynes, 2007b).

Haynes (2007b) thus proposes two approaches to increase office productivity. Firstly, a control paradigm which aims to achieve greater efficiency and which focuses on reducing either the cost or space provision (Haynes, 2007b). Secondly, an enabling paradigm which aims to achieve greater effectiveness by focusing on occupiers being provided with an office environment that enables them to improve their productivity (Haynes, 2007b). The enabling paradigm shows a link between work processes, the work environment and increasing office productivity and is therefore currently the most appropriate approach (Haynes, 2007b).

The WGBC (2013a) provides overwhelming evidence that office design has a significant effect on health, well-being and the productivity of its occupants. Whilst this may be a biased point coming from the council supporting the implementation of green buildings, Leaman and Bordass (2007), Haynes (2007d) and Mallawaarachchi *et al.* (2016) reiterate this point by stating that occupants who are satisfied with their overall environmental quality or IEQ of their workspace have proven to be more productive.

### 2.3.1 Indoor Environment Quality

IEQ and its many components significantly influence the occupants' health, well-being and their productivity (Mallawaarachchi *et al.*, 2016). In a similar manner, occupants also have a significant effect on their own IEQ and specifically on the buildings' energy use (Ouf, Issa and Mallory-Hill, 2013). A healthy IEQ leads to an environment where people feel self-motivated, creative and supportive. Variances in electricity and heat consumption can be attributed to the occupants' behaviour (Ouf *et al.*, 2013). The key components of IEQ and the ones that will be discussed in this study are (1) internal air quality, (2) temperature, (3) humidity, (4) ventilation, (5) lighting, (6) acoustics and (7) ergonomic design and safety (WGBC, 2013a; Byrd and Rasheed, 2016; Mallawaarachchi *et al.*, 2016). IEQ is the environmental qualities within a building, used especially in relation to the health and comfort of the building's occupants (Roulet, Johner, Foradini, Bluysen, Cox, De Oliveira Fernandes, Müller and Aizlewood, 2006; Mallawaarachchi *et al.*, 2016). It is further defined as the interaction between many factors in indoor environments (Ries *et al.*, 2006; Roulet *et al.*, 2006).

There is a dynamic and continuous interaction between occupants and their surroundings that create physiological and psychological effects on the person (Mallawaarachchi *et al.*, 2016). It is important for office buildings to have and maintain a high IEQ as it is known to affect productivity and the health of its occupants (Kamaruzzaman and Sabrani, 2011; Mallawaarachchi *et al.*, 2016). An unhealthy IEQ can have a negative effect on facilities, the building and its occupants (Mallawaarachchi *et al.*, 2016). Increased unhealthy symptoms and lower performance are linked to many indoor design environmental exposure, operation and maintenance issues (MacNaughton *et al.*, 2016). Occupants reported extreme temperatures, poor air quality, excess humidity, insufficient ventilation and psychological health (Singh *et al.*, 2010). The effect of this is higher absenteeism rates, loss of work hours and lower levels of productivity (Singh *et al.*, 2010). A further consideration is a growing trend to be living a healthy and clean life that has less of an impact on the environment. Such individuals will become more conscious of their working environment. A business that espouses that principle, will attract a healthier and better-quality workforce which translates to higher productivity and profitability (Haynes, 2007b; Chadburn *et al.*, 2017). It is also more likely a business will remain in a building that has such returns, a positive result for the investor of the building (Haynes, 2007b).

Sullivan *et al.* (2013) suggests that stakeholders assess the internal environment conditions for two reasons. Firstly, to determine whether environmental conditions are affecting productivity in the office and secondly, to identify problems in the internal environment (Sullivan *et al.*, 2013). Steps towards improving the internal environment would be improving the ventilation, allowing occupants to control openable windows, removing indoor pollutants, introducing daylight and underfloor air distribution systems (Abbaszadeh *et al.*, 2006). There is ample research that shows the benefits of improved indoor environments with more satisfied occupants showing greater levels of well-being and essentially, greater results for the company (Newsham *et al.*, 2013). Thus, an improved IEQ is the goal of sustainable design (Abbaszadeh *et al.*, 2006). Occupants are generally happier and more satisfied when they experience improved air quality and thermal comfort (Abbaszadeh *et al.*, 2006; Newsham *et al.*, 2013). Alterations to these elements can however have a negative effect on acoustics and lighting and this needs to be taken into account (Newsham *et al.*, 2013).

Milton, Glengross and Walters (2000) states a correlation exists between an increase in sick leave and, lower levels of outdoor air supply and complaints of poor IEQ , which causes a loss in productivity (Ries *et al.*, 2006). Mallawaarachchi *et al.* (2016) validates this by saying that the preservation of IEQ is the key strategy to the well-being and productivity of the building's occupants. Healthy occupants are more likely to be motivated to create new ideas and continually improve and be innovative in their workplace. The consensus across the literature is that occupants' health and well-being are directly related to the building's IEQ (Singh *et al.*, 2010; Feige *et al.*, 2013; Newsham *et al.*, 2013; Sullivan *et al.*, 2013; MacNaughton *et al.*, 2016). The result has a major effect on levels of productivity and is thus a vital component in a company's planning. Increased productivity is a benefit of green buildings that carries substantial weight amongst investors, despite the difficulty in measuring the concept, and thus needs to be discussed further (Mallawaarachchi *et al.*, 2016). Whilst this is understood and emphasised, it must not be forgotten that beyond the physical environment, productivity is also reliant on the social environment (Haynes, 2007e).

## 2.4 Productivity

An increase in productivity is a major selling point for any investor looking to improve their return. Beaton, Bombardier, Escorpizo, Zhang, Lacaille, Boonen, Osborne, Anis, Strand and Tugwell (2009) and Sullivan *et al.* (2013) both define productivity simply as the ratio of inputs to outputs. Feige *et al.* (2013) extends this definition to the office environment by saying productivity is the ratio of company turnover to employees. Sullivan *et al.* (2013) keeps the definition vague due to the objective and quantifiable nature of productivity, not always being appropriate to all office jobs. There is therefore no clear definition or standard measure for productivity when referring to the office environment (Sullivan *et al.*, 2013). Inputs such as time and resources are easily identified and measured but outputs in an office environment prove to be more challenging (Haynes, 2008a; Sullivan *et al.*, 2013). The lack of a standard measure makes it difficult to compare the levels of productivity between office occupants, and thus prevents an overall measure of productivity (Sullivan *et al.*, 2013). Byrd and Rasheed (2016) define workforce productivity as the number of goods and services that a worker produces in a given amount of time. The study also points out the difficulty in measuring productivity in the office in this way as most of what is produced is not tangible and the economic impact may not reflect the level of labour intensity (Byrd and Rasheed, 2016).

The cost of hiring employees is considerably higher than the cost of maintaining and operating a building (Clements-Croome, 2003; Sullivan *et al.*, 2013). It is therefore vital for a company to offer a work environment that allows the optimal level of productivity to create the highest possible return on employees (Clements-Croome, 2003). The cost of ensuring this is relatively minor over the life span of the building (Sullivan *et al.*, 2013). A small percentage increase in productivity of even 0.2% can have a significant impact on the profitability of a company (Clements-Croome, 2003). Improvements in productivity have shown to have a significant effect on economic and social phenomena such as economic growth and increasing the standard of living (Miller *et al.*, 2009). Productivity can be improved both by increasing the quantity, *ceteris paribus*, or by improving the quality, of what is produced (Sullivan *et al.*, 2013).

Productivity is influenced by many factors in the workplace such as market forces, technology and more importantly, the input of the individual worker (Beaton *et al.*, 2009).

Feige *et al.* (2013) states that productivity is not definitively correlated to the comfort levels of the employees, but work engagement is. The connection between employee and company allows higher user comfort to reduce the turnover rate of employees (Feige *et al.*, 2013). This in turn can produce higher levels of productivity. Crowded spaces, job dissatisfaction and physical environment are the main issues that affect office productivity according to (Clements-Croome, 2003). Further to this point, Heerwagen (2010) found that in a newly designed building, significant productivity gains were found, with workers reporting a much higher positive feeling regarding the environment (Ries *et al.*, 2006).

Workers reporting health-related problems showed lower levels of productivity (Ries *et al.*, 2006). Low IEQ affected employees directly in the work area by causing discomfort, and indirectly by causing the worker to be absent (Ries *et al.*, 2006). Aspects that affect the productivity of office workers, and that need to be considered, are the outside view from the work area, the air temperature, relative humidity and work area size (Ries *et al.*, 2006). Green alterations to these aspects have been shown to have a significant impact on the workers' productivity (Ries *et al.*, 2006).

Productivity however, is an abstract, latent term and cannot be measured directly due to the multiple components of the construct (Koopmans *et al.*, 2011; de Dear, Akimoto, Arens, Brager, Candido, Cheong, Li, Nishihara, Sekhar, Tanabe, Toftum, Zhang and Zhu, 2013; Sullivan *et al.*, 2013). It is therefore suggested that researchers look at concepts related to work performance, such as absenteeism and job engagement (Koopmans *et al.*, 2011). The measurement of productivity will be discussed in more detail in the next section.

### 2.4.1 Methods for Measuring Productivity

The literature is in support of green buildings because of the benefits to the occupants. Productivity is fairly simple to understand and measured in a manufacturing economy but in the current times, the economy has moved to more service and knowledge-based, making measuring productivity less clear (Haynes, 2007e; Mulville *et al.*, 2016; Nurick and Thatcher, 2021). Newsham *et al.* (2013) and MacNaughton *et al.* (2016) focus on the internal effects in the building that assist occupants in working in a healthier environment. Throughout the discussion of productivity, it is clear to see that it presents challenges when

finding a measurement method. Ries *et al.* (2006) describes it as one of the most difficult concepts to measure as a result of the data requirements and lack of well-defined metrics (de Dear *et al.*, 2013). The factors used to measure productivity prove to either be inherently subjective such as mood or job satisfaction, or are impractical to measure objectively, such as the frequency of issues reported (de Dear *et al.*, 2013; Sullivan *et al.*, 2013). Miller *et al.* (2009) points out the difficulty in collecting data, especially when it comes to professionals and experts (Ries *et al.*, 2006). Their work is incredibly knowledge-intensive and thus difficult to objectively and quantitatively measure (Miller *et al.*, 2009; Thatcher and Milner, 2014; Byrd and Rasheed, 2016; Mulville *et al.*, 2016). Every building has different green features, adding to the complexity of the comparison (Thatcher and Milner, 2014).

Oseland (1999) proposes three approaches to measuring productivity: (1) performance measures, (2) self-assessed productivity and (3) staff costs and profits, stating that self-assessment has provided some useful results in the past (Haynes, 2007e). Alternatively, (Clements-Croome, 2003) bases measurement on three methods: physiological, objective and subjective. Physiological, looking at measures of activation that are associated with increased activity in the nervous system; objective measures, used to deduce the amount of workload physically and mentally; and, lastly, subjective measures, that look at the occupants' perceptions (Clements-Croome, 2003). However, physiological methods are criticised for their sensitivity to contamination and intrusive nature (Clements-Croome, 2003). Objectively measuring productivity requires the researcher to collect quantitative data by looking at the financial and economic performance of the company (Miller *et al.*, 2009). The researcher will look at statistics such as revenue, net income, billable hours etc. (Miller *et al.*, 2009). As Feige *et al.* (2013) suggests, if these statistics are immeasurable, then indirect measures such as absenteeism, tardiness or employee turnover can be used. However, leads and lags of labour and capital may affect the output and prove to be an unreliable measure of productivity (Miller *et al.*, 2009; Fisk, Black and Brunner, 2011). Therefore, it leaves subjective methods that are not based on quantitative operational information to measure productivity.

Subjective methods are based on self-assessment of productivity such as rating scales, questionnaires and interviews (Clements-Croome, 2003). This method is convenient, easy to carry out, cheap and suitable for large samples (Sullivan *et al.*, 2013). The method relies

on the respondents' judgement of their productivity in the work space and thus the measure is termed "perceived productivity" (Sullivan *et al.*, 2013; Byrd and Rasheed, 2016). Sullivan *et al.* (2013) notes that self-assessed measures are often substantially higher, indicating the possibility of bias. The majority of the literature discussed in this study agree that a subjective measure is better than no measure at all (Miller *et al.*, 2009; Feige *et al.*, 2013; Sullivan *et al.*, 2013; Byrd and Rasheed, 2016). However, (Clements-Croome, 2003) argues that whilst a subjective measure is not the desired empirical or quantitative measure, it may be more appropriate and realistic as respondents are likely to work in relation to their feelings. The author does however validly point out something that has not been discussed by other researchers. Whilst the surveys cover a wider range of productivity indicators such as health, well-being, overtime etcetera, it still excludes the effects a respondent's social life may be having on their productivity (Clements-Croome, 2003). This would include factors such as social stresses, loss of sleep, and personal or work relationships (Clements-Croome, 2003). This is further discussed by Nurick and Thatcher (2021) Each factor's level of importance in the respondent's life should be considered in the questionnaire (Clements-Croome, 2003). These factors should be considered in the interview or questionnaire process as additional reasons for occupant's absenteeism and productivity in the workplace, when evaluating an occupant's self-assessment.

#### 2.4.2 Perceived Productivity

Given the subjective nature of the productivity measure, researchers accept self-assessment rather than no measure at all (Haynes, 2008a; Sullivan *et al.*, 2013). Leaman and Bordass (2007) agree with this use by showing how the advantages outweigh the disadvantages (Haynes, 2007e). Occupant surveys are the preferred method of measuring perceived productivity as people have some feeling of how their environment affects their productivity (Sullivan *et al.*, 2013). The method is based on the assumption that occupants are correlating their building IEQ to their level of productivity (Byrd and Rasheed, 2016).

This method is adopted by researchers with caution as although it allows the study to use large samples over a variety of building types, it must be noted that the accuracy of people's judgement is highly questionable (Sullivan *et al.*, 2013; Byrd and Rasheed, 2016). Whilst the survey ratings may reflect something about productivity, having occupants rate

their perceived productivity may have an influence on their actual productivity (Murphy, 2008; Sullivan *et al.*, 2013). It can be a useful measurement comparing relative changes over a period of time (Haynes, 2007e). People tend to struggle to compare themselves to others and often overestimate their ability and productivity on challenging tasks and underestimate these on the simpler tasks (Sullivan *et al.*, 2013). It, therefore, must be emphasised that perceived productivity should only be used as an indication of actual productivity (Sullivan *et al.*, 2013; Byrd and Rasheed, 2016).

### 2.4.3 Link between Green Buildings and Productivity

Whilst researching green buildings and the benefits thereof studies continuously point to productivity gains as the key selling point. In order to encourage investors to lean towards sustainable development, the link between green buildings and productivity needs to be discussed. The link will appeal to developers, commercial users, accrediting organisations and building professionals (Byrd and Rasheed, 2016). This emphasises the importance of discussing this point and identifies a key marketing characteristic of green buildings (Byrd and Rasheed, 2016).

A green building is one that achieves a certain amount of credits under a certain rating system (Byrd and Rasheed, 2016). Kato *et al.* (2009) identify the aspects of green buildings that improve the IEQ. These include improved ventilation, increasing airflow, and thus lowering airborne infections (Kato *et al.*, 2009). The use of less toxic building materials and furnishings, and improved maintenance to reduce the build-up of microbial contamination can all help to lead to a healthier IEQ for occupants (Kato *et al.*, 2009). The use of high-quality energy-efficient lighting as well as increasing the use of natural light, reduces the computer glare and creates a more natural environment (Kato *et al.*, 2009).

The cost benefits of green buildings are not measured by the cost of individual initiatives but by the building costs as a whole (Byrd and Rasheed, 2016). If good facilities management is in place, healthy buildings tend to increase productivity and save energy (Clements-Croome, 2003). The two most important assets that a company has are its property and its people, but often this link is not understood (Haynes, 2007b). Given the relatively small costs of construction and operation of the buildings over its lifetime, in

comparison to the salaries of the workers, the value of the firm's workers and resulting productivity is far greater and thus it makes sense from a financial perspective to focus on the occupants' well-being and productivity levels (Thatcher and Milner, 2012; Sullivan *et al.*, 2013). In early case studies, green buildings have shown evidence of increased productivity, decreased absenteeism, and higher user satisfaction levels (Thatcher and Milner, 2014; Chadburn *et al.*, 2017; Nurick and Thatcher, 2021). More recently, although still positive, cases have shown mixed results regarding productivity, thus not showing consistent improvement (Thatcher and Milner, 2014).

Miller *et al.* (2009) reports that a building with healthier and happier occupants, reduces the sick leave employees take, thus increasing productivity. Past research has shown that natural light, good ventilation and the absence of organic compounds can have a positive effect on productivity (Miller *et al.*, 2009; Chadburn *et al.*, 2017; Nurick and Thatcher, 2021). Even a small increase in productivity can have a substantial effect on the payback time of upgrading the building (Clements-Croome, 2003). The direct impact of a sustainable building would be an improvement in the IEQ, leading to financial benefits (Heerwagen, 2010; Fisk *et al.*, 2011; Feige *et al.*, 2013; Chadburn *et al.*, 2017; Nurick and Thatcher, 2021). Importantly, for clients, a sustainable building leads to lower costs in terms of energy and water consumption, a positive for rentals and possible sales (Miller *et al.*, 2009; Feige *et al.*, 2013).

## 2.5 Chapter Summary

From this literature review, one can see the conflicting opinions on the benefits that green buildings provide, but more importantly, whether green buildings actually increase productivity. Heerwagen (2010) concludes that claims on productivity have not always been consistently supported by empirical evidence. Although there are continuous supportive claims for green buildings, there is a limited number of detailed evaluations involving the impact on occupants in the public domain, something to consider for future research (Thatcher and Milner, 2014). The results discussed by Thatcher and Milner (2014) are suggestive but do not provide conclusive evidence that green buildings do in fact increase the occupants' well-being and are effective in improving the benefits for occupants when compared to normal buildings. The uncertainty in productivity lies in the difficulty researchers have experienced in measuring the concept, with researchers offering both

sides of the argument. The possibility of bias and unreliable results creates more uncertainty amongst investors. For the purpose of this study, perceived productivity will be used as a measurement of productivity as justified by the authors in this literature review.

# Chapter 3: Research Methodology

## 3.1 Introduction

This chapter provides an overview of the research method. The aim is to explain and justify how the findings will be reached in Chapter 4 and to serve as a measure of the reliability of the research. A breakdown of the research method is given followed by a justification on why a qualitative study was chosen. The limitations that were identified in the study are discussed. The process of the data collection method is explained and includes how the questionnaire was formulated. Lastly, the data analysis method is discussed.

## 3.2 Methodology Overview

The methodology overview will look at the research process as a whole. Figure 3.1 shows the sequence of the processes in the research framework. Although the framework appears in a linear sequence, as the study progressed, knowledge gained throughout the process was used to check and adjust certain aspects of the research design.

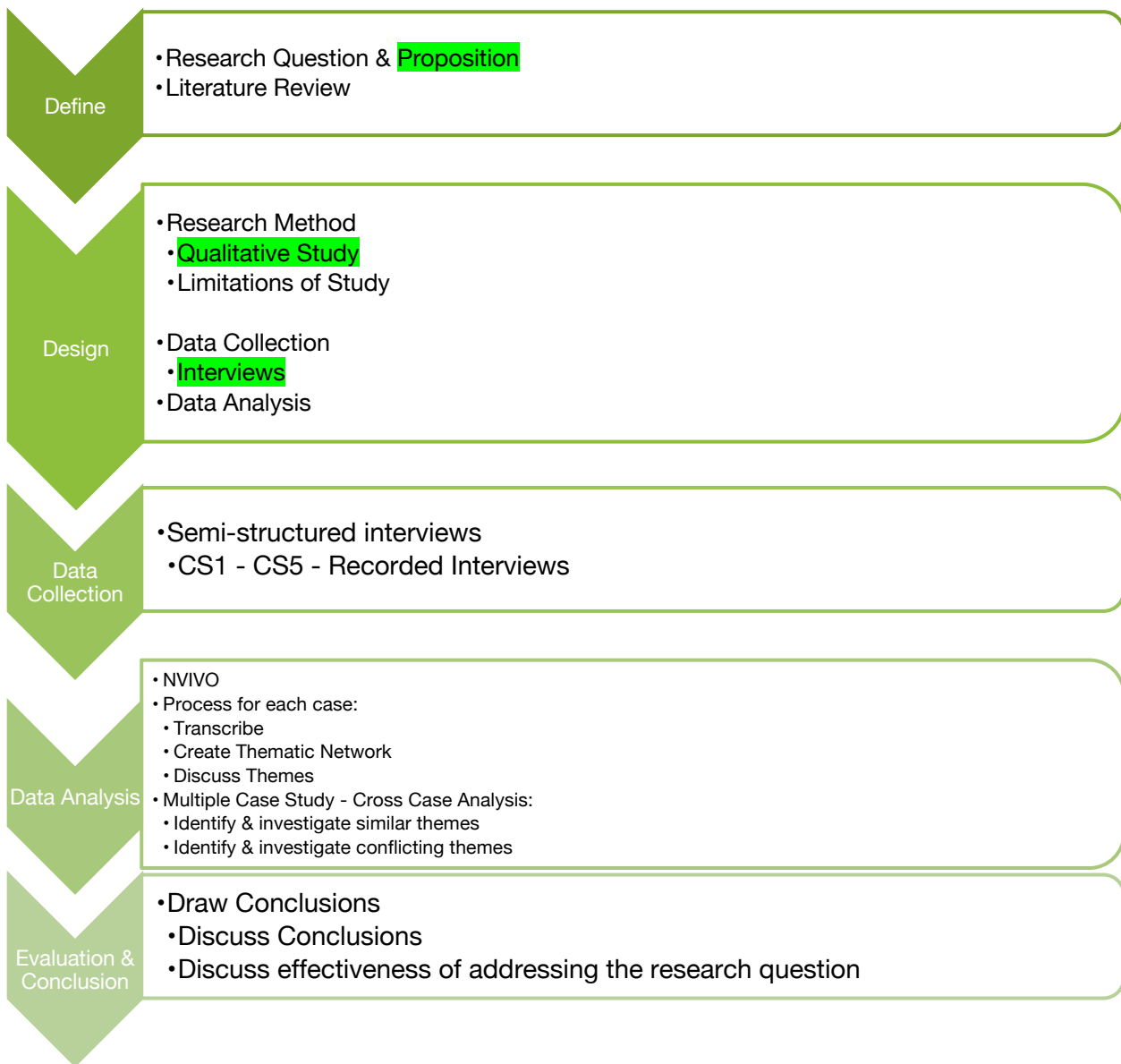


Figure 3.1: Adapted from Research Process Outline (Malhotra and Birks, 2006)

### 3.3 Research Method

This section will describe the research method used in this study and provide justification for its selection. It will define and discuss the use of qualitative research and the associated limitations. More specifically, it will look at the unit of analysis, single and multiple case study design and the sampling strategy.

### 3.3.1 Qualitative Case Study

Primary data can be either quantitative or qualitative in nature (Malhotra and Birks, 2006). There are a variety of reasons why a researcher would choose a particular method. These include the preferences and/or the experience of the researcher and research user, the type of information required from the respondents or observers, or the sensitivity of the information (Malhotra and Birks, 2006).

It is appropriate to use quantitative methods when factual data is required to answer the research question, when the variables can be isolated and defined or when the general or probability information is sought on opinions, attitudes, views, beliefs or preferences (Hammarberg, Kirkman and de Lacey, 2016). Variables must also be able to be linked in order to form hypotheses before the collection of data and the research question or problem is known, clear or unambiguous (Hammarberg *et al.*, 2016). Qualitative research however, is an unstructured, primarily exploratory design based on limited samples, intended to provide insight and understanding (Malhotra and Birks, 2006).

In the case of this research, a qualitative method was chosen and therefore the characteristics thereof are discussed in this section. Qualitative research can be used to help the researcher define a problem, to support quantitative, descriptive or causal research design or as a design in its own right (Malhotra and Birks, 2006). In this study, the qualitative research method has been used on its own to answer questions about experience, meaning and perspective, predominantly from the view point of the participant (Malhotra and Birks, 2006; Hammarberg *et al.*, 2016).

Methods for collecting data for a qualitative research study include using small group discussions to determine beliefs, attitudes and concepts of normative behaviour, semi-structured interviews to investigate views on a focused topic, as in this study (Hammarberg *et al.*, 2016). In this case, key informants are interviewed to gain background information or the institution's perspective (Hammarberg *et al.*, 2016). The subject of the study may also require an in-depth interview, should the research be looking to investigate a condition, event, or experience from a personal perspective of the participant (Hammarberg *et al.*, 2016). As a result, qualitative research is not generally objective or neutral and not hypothesis-driven (Hammarberg *et al.*, 2016). This often causes suspicion to arise over

what is considered a light-weight method as it uses small samples which may not accurately represent the broad population (Hammarberg *et al.*, 2016). This is further discounted by assuming bias from the researcher's own experience or opinion (Hammarberg *et al.*, 2016).

The researcher should focus on the following three points to ensure the credibility of the study is upheld. Firstly, the researcher needs to use rigorous techniques and methods to collect data that is of a high quality (Patton, 1999). At this point, the researcher must pay attention to the validity, reliability, and the process of triangulation, which will be discussed hereafter (Patton, 1999). The study's credibility also depends on the credibility of the researcher and their experience (Patton, 1999). Lastly, the philosophical belief in the value of qualitative inquiry, something that is often lost in qualitative methods due to its creative process, depending on respondents' insights and capabilities of the researcher (Patton, 1999).

Throughout the study, the researcher needs to maintain the quality and integrity of the information and data. This is often an issue that arises in qualitative research due to the nature of the data collection (Flick, 2011). Triangulation is a process used to improve the quality of the research. It means that the researcher goes beyond what is 'normally' done and uses more than a single method (Flick, 2011). In this case, the researcher used the qualitative method, interviews and observations in the buildings and of their features during said interviews. One of South Africa's biggest listed Property Funds also provided information on the buildings and their features, which assisted in the analysis, given that not all green features and initiatives are immediately apparent. This also leads the researcher to observe different methodological perspectives such as objective, facts, subjective attitudes, current and historical issues, and to the buildings and their progress (Flick, 2011).

The several theoretical and methodological methods help to substantiate the perspectives reported (Flick, 2011). Triangulation also refers to combining different sorts of data against the background of the theoretical perspectives (Flick, 2011). It is important to apply all of these perspectives in an equal-resulting manner (Flick, 2011). It should in turn produce

knowledge beyond what is possible with one method, therefore increasing the quality of the research (Flick, 2011).

A common research practice is to maintain an audit trail by keeping track of all raw data, their collection and recordings, and process notes (Flick, 2011). By maintaining a record of all of the information and data collected during the research, there is accountability and guarantees that the pre-defined goals are met and are useful for the application (Kamiske and Brauer, 1995; Flick, 2011).

The researcher uses inductive analysis to describe trends, connections and explanations observed (Patton, 1999). At this point, the researcher must look for opposing or contradictory themes inductively, by rearranging the data and logically by looking for other possibilities and whether this can be supported by the data (Patton, 1999). It is therefore vital that qualitative research is conducted ethically, intelligibly described, and using appropriated and rigorous methods (Cohen and Crabtree, 2006; Cohen and Crabtree, 2008; Hammarberg *et al.*, 2016). Despite the negative stance, some researchers hold on to qualitative methods they are used to, to present detailed descriptions that cannot be measured using quantitative methods (Malhotra and Birks, 2006). Qualitative research uses data collection methods that are sensitive enough to capture the nuances of the respondent, which is often very valuable to the study (Malhotra and Birks, 2006).

### 3.3.3 Limitations of Case Study

Yin (2018) defines a case study as an empirical method that investigates a contemporary phenomenon, the case, in depth and within its real-world context, especially when boundaries between phenomenon and context may not be clearly evident (Yin and Davis, 2007). This is important in a qualitative study where the researcher would want to understand a case in the real-world and observe important contextual conditions that are relevant to the case (Yin and Davis, 2007). This study will perform a cross-case analysis where the researcher will present multiple case studies and perform an analysis (Yin, 2018).

As with any research methods, there are always concerns over possible shortcomings. Firstly, the researcher needs to be rigorous in their research to avoid influencing the

direction of the findings and conclusions (Yin, 2018). Although it is not relevant in this study, non-research case studies can cause confusion, but Yin (2018) does state that this can be avoided by bringing attention to the methodological procedures and further by fairly reporting of all the evidence. As is subsequently discussed, there is an inability to generalise based on a single case study (Yin, 2018). Case studies can be timeous and result in lengthy material, even if this is not necessary (Yin, 2018). Overall, it is unclear what the advantage may be and why a researcher may use them based on the above shortcomings (Yin, 2018). However, case studies offer important insights that may not be discovered in other research methods (Yin, 2018).

In order for the quality of the research designs to be investigated, the following criteria needs to be judged (Yin, 2018):

- Construct validity: identifying the correct operational measures for concepts being studied (Yin, 2018).
- Internal validity: (only used in explanatory or causal research) seeking to establish a causal relationship whereby certain conditions, as distinguished from spurious relationships exist (Yin, 2018).
- External validity: showing whether and how a case study's findings can be generalised, beyond this study (Yin, 2018).
- Reliability: demonstrating that the operations of a study, such as its data collection procedures, can be repeated with the same results (Yin, 2018).

Table 3.1 shows in what part of the research process, each of the four tests can be performed, to establish the quality of the study:

Table 3.1: Research Design Tests adapted from Yin (2018)

Tests	Case Study Tactic	Phase of Case Study Research in which Tactic is addressed
<b>Construct validity</b>	Use multiple sources of evidence	Data Collection
	Have key informants review draft case study report	Composition
<b>Internal validity</b>	Do thematic analysis	Data Analysis
	Do explanation building	
	Address rival explanations	
	Use logic models	
<b>External validity</b>	Use theory in single-case studies	Research Design
	Use replication logic in multiple-case studies	
<b>Reliability</b>	Use case study protocol	Data Collection
	Develop case study database	
	Maintain a chain of evidence	

### 3.3.4 Unit of Analysis

The first step in research design is to determine the unit of analysis in a case study method and more importantly, the correct case (Yin, 2018).

The study's research question is "What is the relationship between green office buildings and the occupant's level of productivity?". This clearly shows the focus of the study is productivity in green buildings, and thus the building where the interview is conducted is the case study, whilst the unit of analysis is individual being interviewed (interviewee). This unit will be assessed in each case study through the interviews conducted with one respondent in each case and how productive each respondent feels. To ensure consistency and a comprehensive representation of each green building, interview respondents were chosen according to their knowledge of the building and business operations, based on the advice of an employee at the aforementioned listed Property Fund who is involved in their green buildings.

### 3.3.5 Multiple Case Study Design

Whilst performing a single-case study design may seem more time-efficient, it is preferred, if the choice and resources are available, for multiple-case designs to be used (Yin, 2017). The analytical benefits of using multiple-case design can be substantial over a single-case design where all resources are dependent on that single case study (Yin, 2017).

### 3.3.6 Sampling

The sampling technique chosen needs to allow the researcher to generalise the finding across green buildings in South Africa. The size of the sample is decided by what is necessary and what is optimal to draw deductions on the population (Marshall, 1996).

This study used a mix of purposive and convenient sampling. The respondents needed to be working in a building that met certain criteria, which forms part of the purposive sampling method as the respondents were specifically targeted. The buildings needed to be green star rated, and more specifically, have a 4-Star rating. The reason being that these buildings would have a certain level of green initiatives implemented, and the workers would more than likely be aware of some of these initiatives and the process these buildings had been through to get to this star rating. As mentioned in Chapter 1, the current sample of six-star

buildings was very limited, thus it was decided to only focus on four- and five-star rated buildings. Many of these building managers were contacted but the listed Property Fund eventually assisted in connecting the researcher with the office employees. Eventually, the researcher was only given access to five 4-Star buildings. This was convenience sampling given the available resources and contacts.

The convenience sampling approach is a less rigorous method, as it uses the most accessible sample to represent the population (Marshall, 1996). Whilst it is sometimes said to report poor quality data, in the case of this study it was the most reliable way to compare buildings that are alike, using people that are actually occupying the buildings. Although they are not necessarily experts on the green initiatives, they are most likely to feel the effects, sometimes subconsciously (Marshall, 1996). The population is not currently very large and a few buildings of the same green star rating represented the population sufficiently.

### 3.4 Data Collection Method

This section discusses the method used to collect data. First, it will look into the use of interviews and more specifically, semi-structured interviews and why this is the most appropriate method of data collection. This is followed by the questions used and the corresponding sources. Lastly there is a discussion on how the labelling of respondents was done to anonymise the sources and the respondents.

#### 3.4.1 Interviews

Given that the researcher was aiming to collect data based on the experience of an occupant, interviews were the optimal way to engage with occupants and allow for an open discussion to be had, rather than limiting the questions to a questionnaire structure. The respondents were able to freely express themselves and do so in an anonymous manner, allowing for more reliable and accurate data.

An interview is targeted directly on the case study topic, whilst providing explanations and personal views on the topic (Yin, 2018). Other methods of collection would not show the respondents' attitudes perceptions and meanings (Yin, 2018). It also allows more of a conversation, and the opportunity to discover unexpected insights that survey-type

methods may otherwise limit. However, the shortcomings of the interview process must be understood to try and mitigate them. Due to the conversation-like method mentioned above, there can be bias, should the question be poorly or incorrectly articulated, which can further create response bias (Yin, 2018). The interviewer also needs to be careful not to create an environment where the respondent answers by saying what they think the interviewer wants to hear (Plonsky and Gurzynski - Weiss, 2014; Yin, 2018). The structure is more fluid with an interview and resembles a guided conversation (Rubin and Rubin, 2012; Yin, 2018).

Interviews were conducted with occupants from five separate green buildings in Cape Town. The interviews were conducted at the convenience of the respondent, which limited the length and variety of interviews. It was therefore imperative to highlight the most pertinent issues required by the research. The building manager with human resources chose the respondent from each building and therefore, the level of management was not consistent across the respondents. They were chosen because they were the most involved in and knowledgeable about the green initiatives in the office space.

Before beginning the interviews, it was necessary to plan and take all of the precautions needed to protect the human subjects in the interviews (Yin, 2018). Once the researcher had created the questionnaire, the Ethics Committee at the University of Cape Town was contacted for approval. The approval is attached in Appendix 4. Once the interviews were arranged, the subjects were contacted and asked to sign a consent form Appendix 1, informing them of the interview process and whom they may contact, should they have any questions. The consent form also ensured their confidentiality and privacy, encouraging them to be comfortable during the interviews (Plonsky and Gurzynski - Weiss, 2014; Yin, 2018).

### 3.4.2 Semi-structured Interviews

A semi-structured interview takes place when an interviewer and respondent engage in a formal interview with the interviewer using a list of questions and topics merely as a guide (Cohen and Crabtree, 2006). This allows flexibility for the interviewer to encourage the respondent to expand on a particular point that may not be in the guide. According to Cohen and Crabtree (2006), a semi-structured interview is appropriate and best used when

there is only one chance to interview each respondent, which was relevant to this study where organisations are unlikely to grant the researcher more than one occasion to interview their employees.

It is important for the interviewer to be prepped and have some experience and knowledge of the topic and the interview process. Whether or not this is the same person, the interviewer and researcher should be a good listener who can easily adapt to any situation (Yin, 2018). The interviewer must also take responsibility for the interview and ensure it is ethically conducted (Yin, 2018). During the data analysis process, the interviewer becomes the instrument for analysis (Nowell, Norris, White and Moules, 2017).

The first interview helped refine the plans for the rest of the interviews (Yin, 2018). This was a very important step in improving the procedures to be followed and the content of data needed for this study (Yin, 2018). This case study also provided some clarification for the research design and the direction in which this study was heading (Yin, 2018). It is important to note that this was not treated as a pilot case, but rather that the researcher was able to learn from each interview and improve in the next. During the interview, the interviewer collected both verbal and non-verbal responses, thus it being important for the interviewer to be perceptive, a point made by (Yin, 2018) and noted by the interviewer.

### 3.4.3 Interview Questions

Using the literature, the researcher created a semi-structured interview outline with 14 questions. These questions, the justification for their choice and their source are displayed in Table 3.2.

*Table 3.2: Interview Questions*

Question:
1. How long have you worked in this office (years)?
Reason and source of question:
To determine the extent of knowledge the occupant may have of the building.
Question:
2. Did you work here before the office moved towards green features/certification?

Reason and source of question:
To determine their knowledge of the building and its features.
Question:
3.1 How long did you work in the office before it acquired green certification (years)?
Reason and source of question:
To determine whether they have a point of comparison for before and after certification (GBCSA, 2018a).
Question:
3.2 Did you feel productive in the office during this time?
Reason and source of question:
To determine the occupant's self-perceived measurement of productivity before it was green certified (Haynes, 2008a; Sullivan <i>et al.</i> , 2013; Byrd and Rasheed, 2016)
Question:
3.3 What components of the indoor environment have contributed to stress levels?
Reason and source of question:
To determine what environmental factors negatively affect the occupant and cause stress (Sullivan <i>et al.</i> , 2013).
Question:
3.4 How did these stresses impact your work life?
Reason and source of question:
To determine what environmental factors negatively affect productivity (Sullivan <i>et al.</i> , 2013).
Question:
3.5 What features of the office did you like and dislike, before green certification?
Reason and source of question:
To determine a point of comparison for the occupant's perception of the green initiatives implemented (Sullivan <i>et al.</i> , 2013) .
Question:
3.6 How has your location in the office changed since green certification?
Reason and source of question:

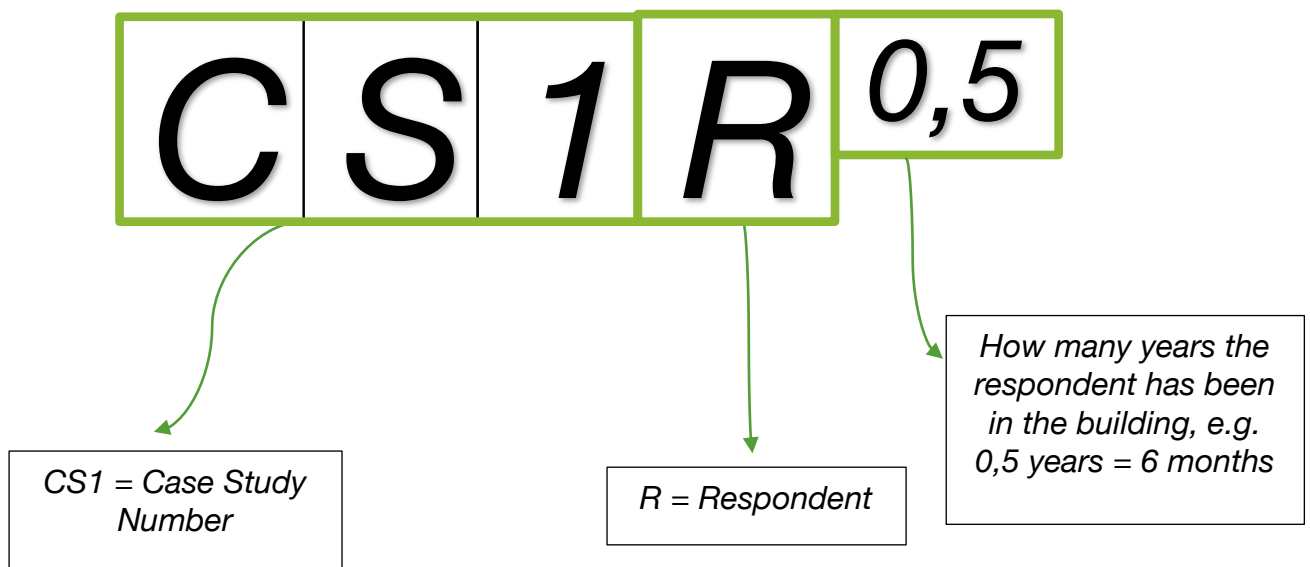
To determine where the occupant was and is currently sitting and how this may affect their perception of productivity as a result (Haynes, 2008b).
Question:
4.1 What green features do you notice in the office now?
Reason and source of question:
To determine what green features have been implemented (Sullivan <i>et al.</i> , 2013).
Question:
4.2 What features of the office do you now like and dislike?
Reason and source of question:
To make comparisons on the occupant's perception of the green initiatives implemented (Sullivan <i>et al.</i> , 2013).
Question:
4.3 Do you feel these features are beneficial to your working environment?
Reason and source of question:
To determine whether the green initiatives are positive or negative additions (Roulet <i>et al.</i> , 2006; Haynes, 2007e; Byrd and Rasheed, 2016).
Question:
4.4 Do you feel productive in the office environment now?
Reason and source of question:
To determine the self-perceived level of productivity since the building has been green certified (Haynes, 2008a; Sullivan <i>et al.</i> , 2013; Byrd and Rasheed, 2016).
Question:
4.5 If yes, explain why you feel more productive or if you have proven to be achieving more.
Reason and source of question:
To determine how the occupant defines productivity (Sullivan <i>et al.</i> , 2013)
Question:
4.6 Are there any components of the indoor environment that help to alleviate stress?
Reason and source of question:
To determine whether the occupant believes there is a connection between the environmental factors and productivity/stress relief (Sullivan <i>et al.</i> , 2013).

### 3.4.4 Respondent Labelling

The respondents in the interviews and their organisation were assured of anonymity. It was thus necessary to label the respondent, maintaining anonymity to ensure the ethical protection of business interests and encourage an open discussion in the interview. As there were just 5 interviews, they were labelled simply with the prefix 'CS' for 'Case Study' followed by a number showing which case study this respondent participated in. This is followed by 'R' for 'Respondent' and a subscript number 1, showing they were the only respondent in each case study and then a super script number, showing how many years they have been working in the green building.

Table 3.3 Respondent Labelling

Respondent Label	Position in Company	Green Star-rated Building
CS1R <sup>6</sup>	Middle Management/Associate	4 Star
CS2R <sup>0,4</sup>	Middle Management/Office manager	4 Star
CS3R <sup>3</sup>	Senior Management	4 Star
CS4R <sup>3</sup>	Assistant Level/CEO Assistant	4 Star
CS5R <sup>2</sup>	Middle Management	Applied for 4 Star (Office only)



## 3.5 Data Analysis Method

The next step is the data analysis which uses the data collected in the interview process that has been completed and transcribed, as available in Appendix 2. The collected data was arranged using the concepts and ideas that were clearly identifiable, allowing the researcher to analyse and highlight common and conflicting themes in each case. Thematic Analysis was used here. Justification of this method is discussed and how this was achieved follows. The software, NVIVO, was used for the coding and a cross-case analysis. Chapter 4 will focus on the analysis.

### 3.5.1 Thematic Analysis

Thematic analysis is a process by which the researcher identifies, analyses, organises, describes and reports the themes found within a data set (Braun and Clarke, 2006; Nowell *et al.*, 2017). It serves as a translator for research of a qualitative and quantitative nature, enabling researchers who use different research methods to communicate with each other (Boyatzis, 1998; Nowell *et al.*, 2017). Further, Braun and Clarke (2006) signify the importance of thematic analysis, by saying it should be the foundational method for qualitative analysis (Nowell *et al.*, 2017). The reason for this being that it delivers the core skills for performing a number of other qualitative research analyses (Nowell *et al.*, 2017). It is therefore imperative that the researcher use thematic analysis in this study, due to the study's qualitative nature.

Whilst a hierarchical structure was constructed in the literature review, this process of thematic analysis identified several themes that were less obvious. The transcripts from the semi-structured interviews were also analysed for themes and connections between themes. Similarities and differences were noted between interviews, providing some important and unexpected insights into this study (King, 2004; Braun and Clarke, 2006).

Despite the advantages presented in thematic analysis, it is always imperative to note the shortcomings of any method, to avoid falling into any of these traps that may invalidate the study. These negatives become more apparent when compared to other qualitative methods (Nowell *et al.*, 2017). There is a lack of significant literature available on thematic

analysis, making researchers, especially amateur researchers, uncertain on how to conduct such analysis comprehensively (Nowell *et al.*, 2017). Whilst some may see the flexibility of the method to be an advantage, it can lead to inconsistencies and a lack of coherence when developing themes resulting from the data (Holloway and Todres, 2003; Nowell *et al.*, 2017). It was suggested by Holloway and Todres (2003) that in order to maintain consistency, the researcher should apply and make explicit an epistemological position that can coherently underpin the study's empirical claims (Nowell *et al.*, 2017).

However, Braun and Clarke (2006) support thematic analysis and provide suggestions for ensuring its success (Nowell *et al.*, 2017). If the analysis is done in a rigorous manner, it can provide trustworthy and insightful information (Braun and Clarke, 2006; Nowell *et al.*, 2017). They do not however agree on how to apply it as rigorously as possible for this type of study. As previously discussed, thematic analysis is a highly flexible method that can be adapted for different studies and provide a detailed, yet complex, account of the data collected and reviewed (King, 2004; Braun and Clarke, 2006; Nowell *et al.*, 2017). It is a more accessible form of analysis in qualitative methods, making it easier and more reliable for novice researchers as it does not require a detailed, theoretical and technological knowledge of other qualitative approaches. This is therefore suitable for this study and where time and experience are research constraints. The thematic analysis involved a six-phased process according to Nowell *et al.* (2017) and Attride-Stirling (2001) as follows:



The above processes allow the researcher to sift through and link themes across large data sets comprehensively. This process is made easier and more transparent through the use of certain software. In this study, NVivo 12 was used to produce results from thematic analysis. This software also creates an audit trail of all of the literature and data captured and reviewed in producing the results in this study. Koch (1994) emphasises the importance of an audit trail as it provides the readers with evidence of the decisions made by the researcher regarding theoretical and methodological issues in the study (Nowell *et al.*, 2017). These issues require clear rationale in decision-making for the study to be executed effectively and efficiently (Koch, 1994; Nowell *et al.*, 2017). A more detailed explanation of these steps is to follow.

### 3.5.2 Steps to Achieve Thematic Analysis

#### *Step 1: Coding Data*

The researcher's first step is to code the data by breaking it down and separating it into meaningful parts (Attride-Stirling, 2001). Basic themes are created by identifying common areas of data. This process makes large amounts of data more accessible and easier to understand. A coding framework is created whereby the researcher identifies recurring common principles in the data. For the recordings of the interviews, the audio was first transcribed into text before being coded.

#### *Step 2: Identifying Themes*

In this step, themes are identified and abstracted from the coded data (Attride-Stirling, 2001). It is important here to analyse the themes and ensure the themes are broad enough to incorporate all of the collected data and avoid repetitiveness. By the end of this process, the researcher should have clearly defined themes and sub-themes (Attride-Stirling, 2001).

#### *Step 3: Constructing Thematic Networks*

This is the final step of phase one and involves forming thematic networks from the themes identified in the previous step. Each global theme is formed by organising themes and subordinate basic themes (Attride-Stirling, 2001). The organising themes that were identified in step 2 are then identified as broader themes here and labelled accordingly. Attride-Stirling (2001) describes organising themes as clustered basic themes. Similarly,

clusters of organisational themes make up global themes, which form the core concept of the study.

The result is a non-hierarchical web-like visual illustration, known as the thematic network, which is shown in Figure 3.2. The researcher can then refine the network by ensuring all of the themes accurately reflect the data. Here adjustments can be made.

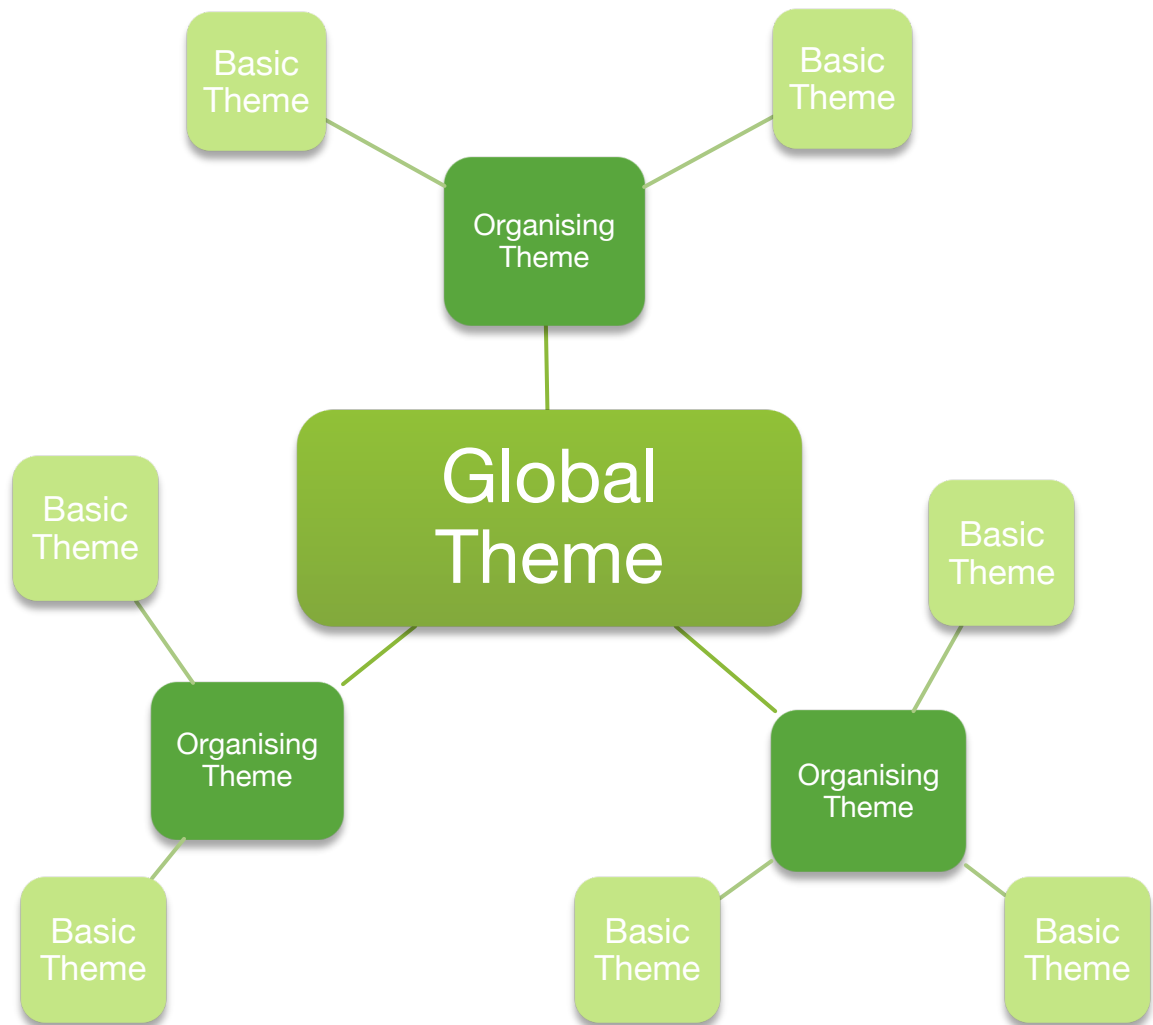


Figure 3.2: Thematic Network (Attride-Stirling, 2001)

*Step 4: Describing and Exploring Thematic Networks*

In step 4, the researcher uses the Global, Organising and Basic themes to read and interpret the original text. Attride-Stirling (2001) says the networks should be read in a clockwise direction to enable the presentation and understanding of the data. The researcher should use this process to describe the network and explore it further to discover the underlying themes that may present themselves.

*Step 5: Summarising Thematic Networks*

The researcher now needs to summarise the thematic network. The main themes that emerged need to be made explicit in order to make the data more compelling. (These can be illustrated in a table such as in Table 3.4, which will also be used for cross-case analysis).

### Step 6: Interpret Themes

The final step involves the researcher bringing the above-mentioned summaries together. The arguments found in the interpretations are used to address the research question (Attride-Stirling, 2001).

The most obvious and forthcoming themes that were identified in the literature were sustainability, green buildings, IEQ, productivity (both increases and decreases), and positive and negative attitudes towards green initiatives. These themes were also identified in the interview transcripts. In certain instances, these themes are connected and overlap, especially in the transcripts where conversation naturally flowed, rather than a structured piece of literature.

### 3.5.3 Cross-case Analysis

Cross-case analysis is a process where research draws attention to the differences and similarities across the themes identified in the case studies and across the green office buildings (Attride-Stirling, 2001). This process produced Table 3.4 which was discussed in Step 5 of the Thematic Analysis explanation.

*Colour-coding* was used to show how the different concepts were either similar or dissimilar. Green was used to indicate a strong similarity concept whilst red was used to show where the concepts were strongly dissimilar. Where a concept was similar to one, but dissimilar to another, a green block was used with red font.

Table 3.4 Cross-Case Analysis Example

<b>Global Theme</b>			
	<b>Organising Theme 1</b>	<b>Organising Theme 2</b>	<b>Organising Theme 3</b>
<b>CS1</b>	Concept 1A	Concept 2A	Concept 3A
<b>CS2</b>	Concept 1B	Concept 2B	Concept 3B
<b>CS3</b>	Concept 1C	Concept 2C	Concept 3C
<b>CS4</b>	Concept 1D	Concept 2D	Concept 3D
<b>CS5</b>	Concept 1E	Concept 2E	Concept 3E

These concepts are further explored in the findings section of chapter 4, which allowed the researcher to draw conclusions based on the most important concepts. The reliability of such conclusions depended on the similarity level of each concept.

### 3.6 Summary of Chapter

The focus of this chapter was focused on the research methodology of this study. Case study design and specifically multiple case study design were introduced and justified as the method used. The unit of analysis was determined as productivity. The sampling technique suited to this study was defined and explained.

Semi-structured interviews were used for data collection, where questions were set as a guide for the interviews. It was important to maintain the anonymity of the respondents and so respondent labelling was applied. Further, a thematic data analysis approach was adopted, explained and justified, including the step-by-step procedure.

# Chapter 4: Findings and Data Analysis

## 4.1 Introduction

Chapter 4 aims to present and discuss the findings from the data collected in the interview process. The five interviews were conducted in five buildings each forming a case study, which is discussed initially, to describe some of the features of these buildings. The researcher then analysed the findings by comparing significant themes with the arguments identified in the literature. Thereafter, the cross-case analysis is performed and discussed to identify the similarities and dissimilarities among the responses retrieved from the interviews. This also includes an overview of the respondents' perceptions relevant to the common themes identified.

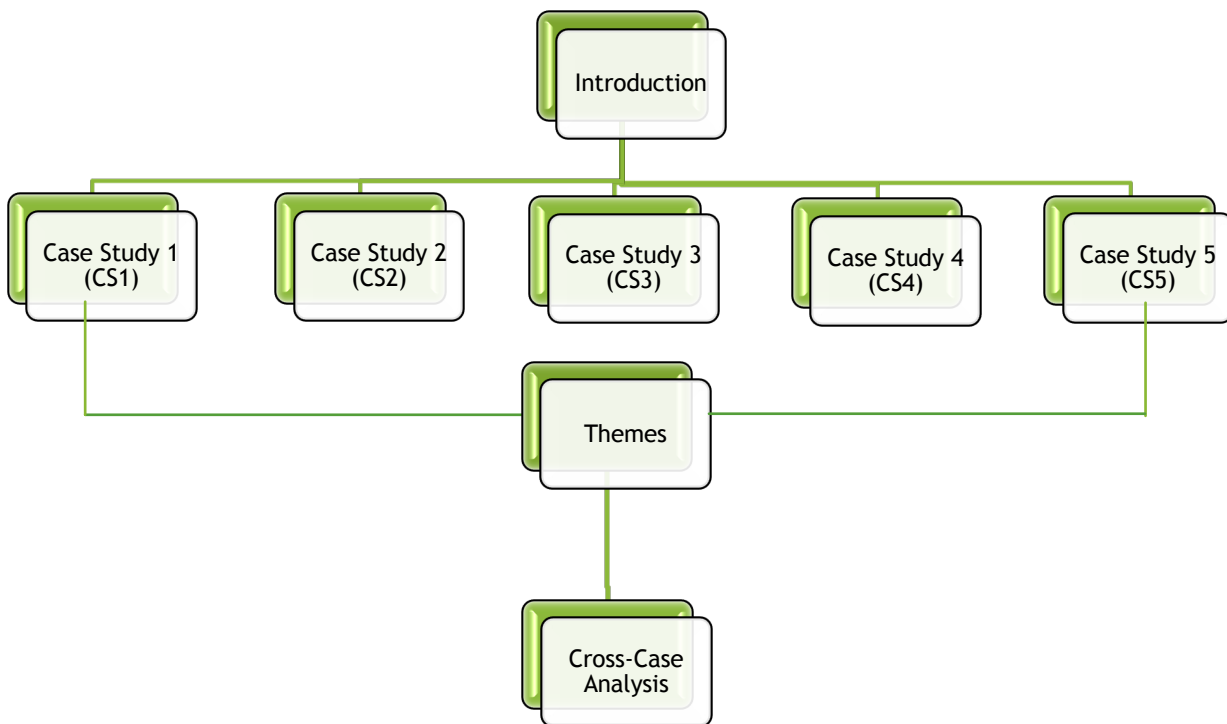


Figure 4.1 Overview of Chapter

## 4.2 Case Study 1 (CS1)

### 4.2.1 Overview

Case Study 1 is a mixed-use development that gained a 4-star rating in January 2019. The building is multi-tenanted with 5250m<sup>2</sup> of rentable office space and 1505m<sup>2</sup> of retail space. There is also parking and site security facilities. The interview was conducted with a tenant of the office portion of the building. The building scored 45 points, performing highest in indoor environmental quality and in land-use and ecology categories.

The building's sustainable features include:

- Occupancy sensors
- Natural daylight
- Perimeter & internal space zoning
- Fresh air levels exceed regulatory requirements
- Reduced glare

### 4.2.2 Green Features & IEQ

CS1R<sup>6</sup> reported that the building had very few green features, but that it was an improvement from their previous office. These features include user control on the windows, water-saving initiatives, open-plan offices, recycling, and a green position statement that encouraged employees to be more green-conscious in their own lives. This contradicts the generalised statement made by Newsham *et al.* (2013) that states that occupant ratings are higher in green buildings in terms of environmental satisfaction. Not all of these initiatives were well received in the office, and many caused more problems that affected the occupants, according to the respondent.

CS1R<sup>6</sup> spoke of the good views and natural feeling in the office with natural light and ventilation, but this also meant that the light was not always optimal for work and there was an issue with pest control, with the windows being open. However, the windows user control and natural ventilation and the open-plan office decrease the need for heating and cooling of individual offices. This rarely causes disruption when there are disagreements on the temperature of the office. The open-plan office provides ease of communication but can also cause great distraction with the noise and movement which is a concern raised by Kato *et al.* (2009). CS1R<sup>6</sup> said they would be more productive if they had their own offices,

as CS1R<sup>6</sup> comes and goes at different times to the colleagues, often causing a disturbance. The respondent believes the open office works for lower-level management and whilst senior level is already in cellular offices, CS1R<sup>6</sup> thinks middle management should be too, both for productivity and morale.

### 4.2.3 Productivity

CS1R<sup>6</sup> responded to the topic of productivity with a fair bit of knowledge. The company has a specific measurement for their productivity by looking at financial metrics for project performance and performance relative to salary and metrics for measuring performance on non-chargeable items such as risk work and final stage work. Given the creative nature of the company's business, it is necessary to have these measurements in place. This is particularly relevant given the nature of the business as it falls directly in line with what Byrd and Rasheed (2016) said that most of what is produced is not tangible and economic impact may not reflect the level of labour intensity.

*"It's a bit different because this is a creative discipline so it might take me five minutes to get the concept, but it can also take me two months to get the concept but it's the same outcome. So that is when productivity is measured on its financial metric" - CS1R<sup>6</sup>.*

CS1R<sup>6</sup> feels that there would be more productivity in a closed office, as it can become quite noisy with the number of people in an open space talking. When discussing the old office with his current office, CS1R<sup>6</sup> explained how the productivity had improved due to the environment in the current office but that there was also a change in management which had helped. CS1R<sup>6</sup> was not adamant that the environment was the only reason for the improvement, and that some of these green features were actually causing more disturbance to his own productivity.

## 4.3 Case Study 2 (CS2)

### 4.3.1 Overview

Case Study 2 is a 14-year-old building in Cape Town. It was awarded a 4-star rating in March 2015. The building is grade-A multi-tenanted office space, spread over three floors.

It scored a total of 51 points, performing best in energy and water. The extensive list of sustainable building features includes:

- Green cleaning and solid waste and materials management policies
- Basic monitoring strategy
- Sufficient daylight penetration
- Indoor air quality manager has been appointed
- Multiple green management plans in place
- Waste stream audit undertaken
- Energy usage efficiency improvements of 45% over the benchmark
- Water usage efficiency improvements of 89% over the benchmark

### 4.3.2 Green Features & IEQ

CS2R<sup>0,4</sup> was a fairly new employee to the building, but the company had a green focus and was quickly brought up to speed on the initiatives in the office. The office independently implemented recycling, but as the building did not enforce it, the respondent was unsure whether the recycling was actually dealt with correctly once it went into the building refuse room. The light bulbs in the office are not energy-saving but they do maximise the use of natural light by having big windows and the blinds lifted. This also allows them to have natural ventilation although CS2R<sup>0,4</sup> said they do use air-conditioning on occasions. The double-glazing on the windows is not as effective as the respondent would have hoped as it is still noisy and hot in the summer.

CS2R<sup>0,4</sup> would like to speak to management about lessening the number of light bulbs in the office as there is an unnecessary amount. The respondent believes that in addition to reducing the number of lightbulbs in the office, the air conditioner is also far too powerful.

It is being used the small space it is being used for and could be reduced to save electricity and unnatural cooling or heating.

CS2R<sup>0.4</sup> spoke of the culture in the office, whereby employees are encouraged to save water, not use single-use plastic and to reduce electricity usage when they are not at work. The company emphasises sustainability and consideration for the environment, going so far as giving their clients reusable, non-toxic bags and creating events whereby the employees do beach clean-ups. Given that the company is not corporate, they aim to create a non-toxic tone and environment in the office letting in natural light, using de-humidifiers and green cleaning products.

*“We have to be because of our company because our company is very big on sustainability. Not that we don’t have a choice, but we need to consider the environment... So it’s part of our DNA to be like that” - CS2R<sup>0.4</sup>*

The open-plan office works for the type of business as they can easily communicate and be creative but in the respondent’s previous office, which was more corporate, it did present its problems. Every quarter or so, the employees move their desks, giving them a new space and this helps to promote productivity and helps anyone who may be uncomfortable in their current space, knowing they are not stuck there. This lines up with the literature where Schwede *et al.* (2008) states that in general, workers are more satisfied and perform better when presented with a new or recently improved workspace. Moving employees’ desks every quarter gives them a physiological and psychological change that can promote productivity (MacNaughton *et al.*, 2016). CS2R<sup>0.4</sup> also speaks of personal or work stresses that are inevitable and says the tone and IEQ of the office provide some relief, but all of the employees do try and keep personal stress out of their work life and productivity. Overall CS2R<sup>0.4</sup> felt that while the current features were positive, a lot that could be done and would require some input from management.

### 4.3.3 Productivity

CS2R<sup>0.4</sup> reported that despite the improvements that could be made, the current IEQ was conducive to productivity and the difference had been noticed. None of the features had

been detrimental to the working environment. Since the respondent's previous job, CS2R<sup>0,4</sup> says that the level of productivity has improved and when asked whether the environment played a role in this, the respondent agreed it had. The green initiatives are making the respondent more motivated and the difference from the previous office is apparent, where small things like all plants were removed from the office. In this current office, they have many live plants that helped them feel healthier and happier and helped to alleviate stress.

CS2R<sup>0,4</sup> measures productivity by seeing where the deadlines are and how quickly and efficiently they are achieved. The work changes every day, so it is difficult to have a standard measure of productivity, resulting in a self-assessment thereof.

## 4.4 Case Study 3 (CS3)

### 4.4.1 Overview

Case Study 3 is a commercial office park with 7600m<sup>2</sup> of A-grade offices. There are several of companies in the complex and have been rated by the GBCSA as a 4-star existing building performance since September 2016.

The building scored a total of 48 points with its highest allocation being for water and land-use and ecology. The building has the following sustainable features:

- Building users' guide
- Operations maintenance planning & schedules
- Various plans such as green travel plan, landscape management plan, integrated pest management plan and storm water management plan.
- Green cleaning policy
- Sufficient daylight penetration
- Energy and water usage efficiency improvements above the benchmarks
- Solid waste and materials management policy

### 4.4.2 Green Features & IEQ

CS3R<sup>3</sup> previously worked in the building next door for nine years before moving to the current office. The new office has been implementing green features since moving in and the respondent has only noticed the significant difference on the IEQ since moving. In the previous office, it was very dark and stuffy with many cellular offices, which often caused fatigue.

*"...It was very dark and stuffy. They had all of these small offices everywhere and it wasn't really open plan so it was stuffy and dark and you did feel lethargic during the day and you could definitely see the effect...You feel like you want to get out, the feeling of being captured..."* - CS3R<sup>3</sup>

CS3R<sup>3</sup> said it was a fairly standard office and nothing really stood out, but also didn't know any better. As Ries *et al.* (2006) stated, poor IEQ affects employees directly in the work area by causing discomfort and indirectly causing the worker to be absent. The cellular offices were not conducive to this line of work and the respondent would have preferred to be in an open-plan office, where there is more light and air, but also to have more human interaction. The respondent pointed out how, being in a cellular office, seeing other people during the day was very rare.

In the new office, the respondent noticed the natural light and warmth from the sunlight and the air is controlled by the environment and less so by the air-conditioning. It also is an open-plan office so the whole IEQ is more natural. Whilst there are some challenges with the open-plan office, the respondent has seen an improvement in interaction and productivity. Noise levels are higher and consideration needs to be taken for everyone in the office which was not an issue in a cellular office but overall the natural light and fresh air have made a significant difference. The building has also implemented a grey water system and encouraged recycling. There is a different mood and mindset in the office. There has been a change in behaviour with people bringing plants to work, which helps alleviate stress from a very stressful job. CS3R<sup>3</sup> believes there is still more that can be done, but the changes have already been very positive. CS3R<sup>3</sup> overall feels much better and more positive because of the environment.

#### 4.4.3 Productivity

CS3R<sup>3</sup> explained that they have a few metrics to measure productivity but none of them are directly comparable. They look at stakeholder satisfaction, more specifically team and customer satisfaction. They look at project goals based on installation and whether the team is performing as they have set out to do. A number of outlets in the building that encourage employees to take a break when things are stressful and return to work more productive. These include table tennis and boxing outside in the courtyard.

As previously mentioned CS3R<sup>3</sup> worked in the building next door and during the time, felt productive and was measuring it by reaching the KPIs and receiving good reviews for the work. However, once the respondent moved to the new, greener office, it was noticeable how this productivity changed for the better. The dark and stuffy office caused the

respondent to feel lethargic and felt productivity drop during the day. Abbaszadeh *et al.* (2006) emphasised that occupants are generally happier and more satisfied when they experience improved air quality and thermal comfort, which is evident in CS3R<sup>3</sup>'s response. CS3R<sup>3</sup> said when arriving, there was this feeling of struggling to wake up with no fresh air and as the day progressed, felt increasingly fatigued.

CS3R<sup>3</sup> says the initiatives have improved productivity, employee happiness and collaboration. The respondent has noticed that the team is working better and overall seem happier because of the environment. This is in line with what Mallawaarachchi *et al.* (2016)'s research found that healthy occupants are more likely to be motivated to create new ideas and continually improve and be innovative in their workplace. The lights turn off when people leave the bathrooms to save electricity. However the respondent says all of their computers and machines in the office stay on all night, but they are working on improving that.

As with any job, CS3R<sup>3</sup> speaks of how external stresses affect the work environment but feels the IEQ and green features help alleviate some of these stresses. The environment is more natural and positive as the company works on providing employees with a happy and supportive workspace.

The new office is open plan and more conducive to productive communication and motivation but has presented its challenges with more disturbance but has been an improvement overall. The positives of these initiatives reach beyond productivity. CS3R<sup>3</sup> reports improved employee wellness and stress being dealt with far better due to a more positive mindset.

## 4.5 Case Study 4 (CS4)

### 4.5.1 Overview

The GBSCA presented Case Study 4 with a 4-star rating in October 2016. The office park is a commercial office development with 14463m<sup>2</sup> of rentable B-grade office space with parking and site security facilities. It is multi-tenanted. The office park scored a total of 45 points with the highest allocations being land-use, energy, and transport.

Green building features include:

- Green cleaning and solid waste and materials Management Policies
- Periodic testing of temperature, humidity, airspeed, and radiant heat
- Water and energy usage efficiency improvements over the benchmark
- Sufficient daylight penetration

### 4.4.2 Green Features & IEQ

CS4R<sup>3</sup> is the office manager and in charge of the carbon emissions report and thus had extensive knowledge of the green features in the office. With the recent “Day Zero” water crisis campaign in the Western Cape, the office had implemented any initiatives in the office and even since the restrictions had been relaxed, the office had maintained these measures such as reducing the water pressure and restricting the use of some basins and length of time the automatic tap runs for. Water tanks and boreholes were installed in recent years to be used to water the gardens.

Every quarter, management meets with the carbon emissions team globally and discusses any additional initiatives needed, where they are in terms of rating, their score, and the office’s carbon footprint in that period compared to the previous quarter. This has created an environmental consciousness amongst the office workers. Clements-Croome (2003)’s research showed that good facilities management and a healthy IEQ would lead to increased productivity and save energy in the office. This shows how the respondent is involved in the green processes, and encouragement is given to the entire office.

In the office, CS4R<sup>3</sup> reported recycling, LED energy-saving lightbulbs, night sensors whereby all the lights turn off at night except for emergency lighting, double-glazed windows and all of their pips and seeds from the kitchen go to the cleaning lady, who plants them in her community. All stationery and paper that cannot be used are also sent home with the cleaning lady who hands them out to underprivileged schools so that nothing is thrown away. CS4R<sup>3</sup> tried to implement green cleaning products, but that it was not easy to source through the suppliers approved by head office and took up too much time. It is encouraged that employees only use reusable cutlery and crockery, and water coolers were installed to reduce the number of plastic bottles in the office. All of their computer screens are energy saving. The windows are kept closed and the air conditioning is kept at a constant temperature. The use of high-quality energy-efficient lighting, in addition to increasing the use of natural light, reduces computer glare and creates a more natural environment (Kato *et al.*, 2009). In this case study, the natural lighting caused more glare, but this was quickly rectified without compromising the positive effect of the green initiatives. This was a concern raised by Kato *et al.* (2009), that not all green initiatives are comfortable but it takes action by the company to rectify this.

*“And we have these shades so if the blinds are open then I can pull down these shades...It was just unpleasant to work like that. It caused high strain and a headache, but I raised it and it was sorted out” - CS4R<sup>3</sup>*

Employees are encouraged to conduct meetings over video calls where possible and avoid travel where possible. The offices are at the back, where most of the employees sit, is open plan. CS4R<sup>3</sup> feels like that has a positive effect on the environment as it is very quiet and if someone does speak, they are very respectful and keep it at a decent tone. The open plan office is conducive to the nature of work the senior employees are doing and allow for more productive communication. CS4R<sup>3</sup> however works in a separate space on the other side of a wall from the open plan office. The respondent finds this works well as the roles include managing the office and being an assistant to the CEO. CS4R<sup>3</sup> initially struggled with glare from the natural light, but when mentioned to head office, this was immediately corrected not to affect the respondent further.

### 4.4.3 Productivity

CS4R<sup>3</sup> measures productivity by looking at the list of tasks and assessing how quickly that list is completed. However, when looking at a project, the respondent likes to assess the level of productivity once the project has been taken full circle, and the respondent can see whether the timeline was abided by. The company also holds a performance review process throughout the year, which allows the employees to account for their productivity and see whether they are achieving these goals. As a result, CS4R<sup>3</sup> feels more productive now than before.

CS4R<sup>3</sup> reports that it is not definite that the initiatives have improved productivity but that it has improved the environment and how the respondent feels about it. CS4R<sup>3</sup> says that people seem a lot happier when everyone is complying with the green initiatives. CS4R<sup>3</sup>'s response is in line with Abbaszadeh *et al.* (2006)'s research on IEQ and the effect this has on occupant's satisfaction and comfort. The company is very determined to keep their employees comfortable and focus on the ergonomics of the workstations, to maximise productivity. Whilst CS4R<sup>3</sup> cannot pinpoint particular initiatives that affect the level of productivity, the overall green environment and care for the employees creates a positive environment which CS4R<sup>3</sup> has noticed. There is definitely an improvement to the office employees' health, and this has been seen through very low absenteeism, a result of improved IEQ, according to Singh *et al.* (2010). This is validated by Milton *et al.* (2000) who states a correlation exists between an increase in sick leave and complaints of a low IEQ. A sense of motivation and satisfaction is created by implementing these initiatives in the office leading to good morale amongst employees which translates to better productivity and profitability (Haynes, 2007b).

## 4.6 Case Study 5 (CS5)

### 4.6.1 Overview

Case Study 5 (CS5) is a mixed-use development building, built in 2016 in Cape Town consisting of 8087m<sup>2</sup> GLA. While the building has applied for 4-Star rating, the office where the case study was conducted, has implemented its own green initiatives. In 2017, the building boasted a 50% reduction in water usage in response to the water crisis. The building has implemented the following initiatives:

- Energy-efficient LED lighting in parking garages, saving 41%
- Green leasing criteria introduced
- Indoor air quality management strategy
- New system installed for better trending and HVAC control

### 4.6.2 Green Features & IEQ

CS5R<sup>2</sup> worked in an office that had implemented many green initiatives but the building as a whole was not certified green. The respondent previously worked in a building that was not at all green and so had a seen a lot of change since moving. CS5R<sup>2</sup>'s previous job was in an old building and so moving to a modern office was a big change. The old building made the respondent feel sick daily and noticed upon leaving each day, that feeling would go away. The lighting was yellow, the windows were not open, and they relied on air conditioning. CS5R<sup>2</sup> said that every day was a struggle, and it was a relief at the end of the workday. Increased unhealthy symptoms and lower performance are linked to many indoor design elements such as environmental exposure, operation and maintenance issues (MacNaughton *et al.*, 2016)

Since moving office, CS5R<sup>2</sup> has noticed a huge difference, with bright white lighting, fresh air and a more natural environment. The air conditioning is controlled at a constant level by the building, which is comfortable. The respondent is still sitting in an open plan office, but does not feel this affects the IEQ. The boardroom has sensors that turn the lights off after a certain amount of time without movement. The office encourages recycling and implemented a printing system whereby you have to log in to print, making employees more

conscious of their printing and whether or not it is necessary. CS5R<sup>2</sup> did not report any negative initiatives when asked.

### 4.6.3 Productivity

CS5R<sup>2</sup> measures productivity by how efficiently the monthly tasks are completed and how much time there is to visit the clients at the end of the month. As the tasks are generally repeated on a monthly basis, it is quite simple to see the level of productivity. This is a very obvious example of self-assessed productivity. There is evidence that states perceived productivity might reflect actual productivity, as people are aware of how the environment affects them and thus their perceived productivity in fact influences a person's real productivity (Sullivan *et al.*, 2013). CS5R<sup>2</sup> reported an increase in productivity just from moving from an old building to the current, more green office. Whilst CS5R<sup>2</sup> worked very hard in the previous job, it was different and very high pressure. In this environment, the respondent finds it easier to work.

*"...how you feel when you come to work, how you feel when you leave here, It's just a breeze."* - CS5R<sup>2</sup>

The above quote shows the level of comfort the respondent is now feeling (Leaman and Bordass, 2007). The change in the office environment and the green initiatives implemented have created a positive environment for employees, making the workspace a happier and healthier place.

## 4.7 Cross-Case Analysis

This section aims to perform the cross-case analysis by exploring the themes that arose from each of the five case studies and highlight the similarities and those that are exclusive. The global, organizing and basic themes are illustrated in Figure 5.2.

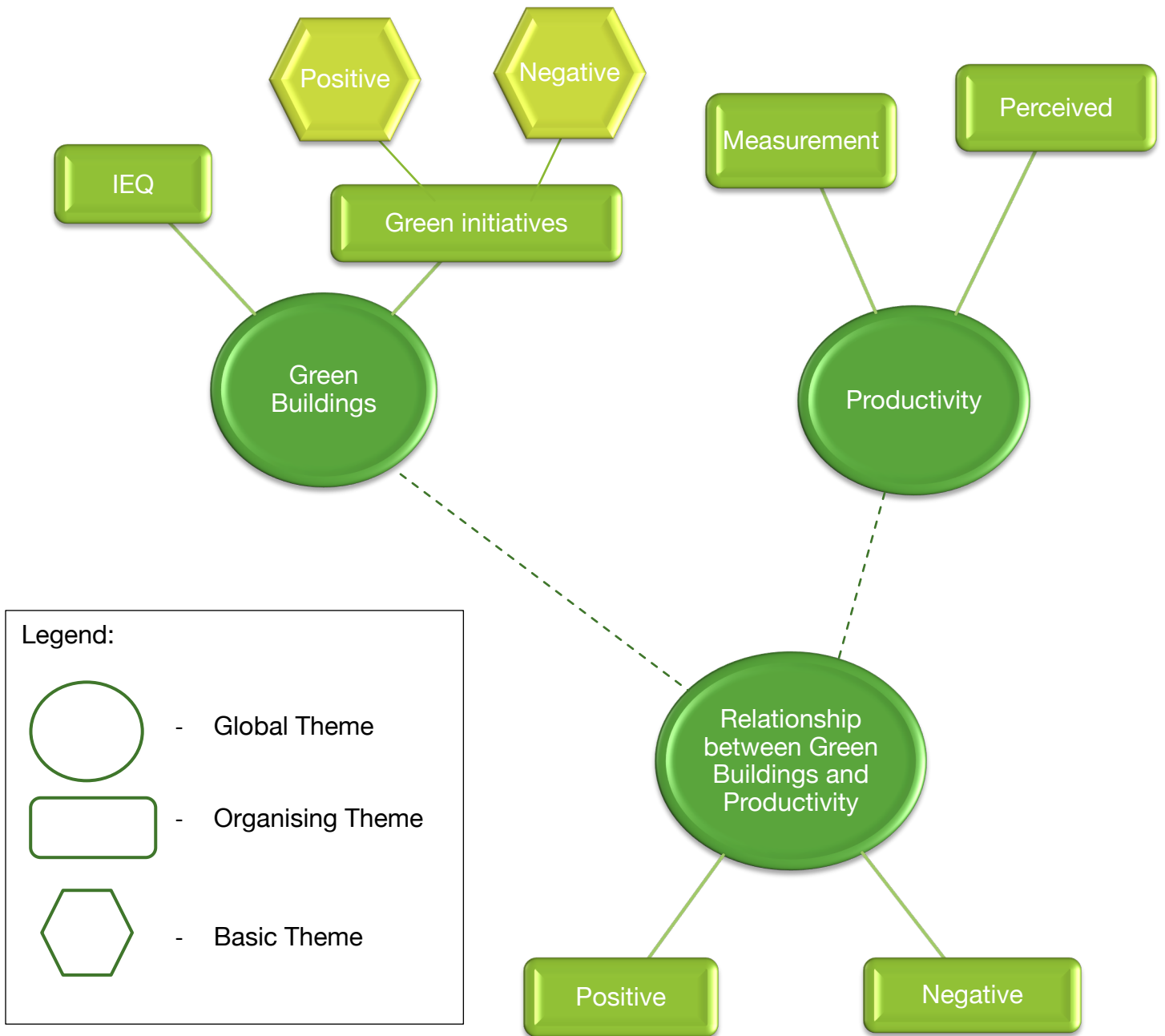


Figure 4.2: Finding themes and sub-themes

An overarching global theme was identified as the Relationship between Green Buildings and Productivity. From there, two more global themes were identified, namely Productivity and Green Buildings. Productivity covers the Measurement of Productivity and Perceived Productivity. Green Buildings discusses the green initiatives in the building and the IEQ.

The first global theme is Productivity, which looked at how respondents measured their productivity in the office. Given the difficulty with defining productivity, respondents were asked to self-assess their productivity, leading to the basic theme, Perceived Productivity ((Haynes, 2007e; 2008a; Miller *et al.*, 2009; Sullivan *et al.*, 2013). The respondents were also asked to explain whether they felt their level of productivity had changed.

The second global theme is Green Buildings, which addresses the green initiatives that have been implemented into each office. These initiatives varied from creating a green consciousness in the office and implementing of green processes, to structural changes to the office. Green Initiatives is further supported by basic themes, positive initiatives and negative initiatives. This global theme also looks at the IEQ of the office, taking into account all of the green initiatives and how this might affect the seven criteria of IEQ; (1) internal air quality, (2) temperature, (3) humidity, (4) ventilation, (5) lighting, (6) acoustics and (7) ergonomic design and safety (Byrd and Rasheed, 2016).

The final global theme is the Relationship between Green Buildings and Productivity. Respondents were asked if they could draw a link between the two and whether it was a positive or negative relationship. This theme forms the core of the entire study. All of the literature and findings lead to this theme.

#### 4.7.1 Green Buildings

##### *Green Initiatives*

Given that four out of five buildings were 4-Star rated, with the fifth building applying for 4-Star rating, the green initiatives were prevalent. All of the respondents were aware of several initiatives and had noticed what difference these had made to the office environment.

Abbaszadeh *et al.* (2006) suggest that to improve the IEQ, one should improve ventilation, allow occupants to control openable windows, remove indoor pollutants, and introduce daylight. Initiatives that were common across all of the case studies (CS1R<sup>6</sup>- CS5R<sup>2</sup>) were natural light and ventilation, recycling, water-saving initiatives, open-plan offices, and a general green consciousness in the office. These are all quite simple initiatives to implement but as MacNaughton *et al.* (2016) and Singh *et al.* (2010) state, poor features such as bad ventilation, lighting and temperature can lead to unhealthy symptoms and lower

performance levels. It is thus in the interest of the company to implement small initiatives where possible to increase the well-being of occupants and achieve better results for the company (Newsham *et al.*, 2013)

When looking at the impact of the initiatives, the majority were reported as positive, however there were a few cases where respondents felt the initiatives implemented were not beneficial to the environment. CS1R<sup>6</sup> reported that the natural ventilation often caused pest control issues as the windows were left open to cool the office, rather than the use of air-conditioning. CS1R<sup>6</sup> and CS3R<sup>3</sup> reported that while the open-plan office was conducive to their creative flow, the distractions were a downside, a concern that was raised by Kato *et al.* (2009) and therefore this design needs to be refined. CS1R<sup>6</sup> specifically mentioned that a private office would increase the productivity of all of the staff in the office as the respondent's office hours are different from others and are a cause for distraction. CS2R<sup>0,4</sup> and CS5R<sup>2</sup> said the open plan presented no challenges and worked well for their line of work, allowing for open communication and collaboration. CS4R<sup>3</sup> worked in a more formal environment where people were very respectful of the noise levels and kept the volume to a minimum, and so the open-plan office proved to be successful and beneficial to those working in teams.

The consensus between CS2R<sup>0,4</sup>, CS3R<sup>3</sup>, CS4R<sup>3</sup>, and CS5R<sup>2</sup> was that the green initiatives were beneficial to their work environment and had created a positive and healthy office by being motivated to care for the environment and encourage others to do the same. Where there was an issue with glare from natural light in CS4R<sup>3</sup>'s office, this was quickly and easily rectified with blinds that still allow in the natural light. CS1R<sup>6</sup> was not as positive overall with all of the initiatives however it was apparent that the respondent had noticed an improvement in the environment from the previous non-green office, even if the new office had a few faults.

### IEQ

IEQ criteria include (1) internal air quality, (2) temperature, (3) humidity, (4) ventilation, (5) lighting, (6) acoustics and (7) ergonomic design and safety (Byrd and Rasheed, 2016). All five case studies reported natural light and natural ventilation with the occasional use of air-conditioning in the office. A comfortable temperature was kept across the office. CS4R<sup>3</sup>

and CS5R<sup>2</sup> were all happy with the noise levels, whilst CS1R<sup>6</sup>, CS2R<sup>0,4</sup>, and CS3R<sup>3</sup> had a few complaints although CS2R<sup>0,4</sup> was very positive about the good communication an open plan office created. CS1R<sup>6</sup> reported a great improvement in IEQ since moving from a tower-type building to the green office, where there was almost no natural feeling in the environment. The new office, however, feels very natural and this was echoed by CS3R<sup>3</sup>. CS2R<sup>0,4</sup>, CS3R<sup>3</sup>, CS4R<sup>3</sup> and CS5R<sup>2</sup> all spoke of the happier and more comfortable environment they worked in and were positive about the changes being made. CS1R<sup>6</sup> was the only case that felt further significant improvements could be made but that these were personal issues, due to differing office hours as mentioned above.

The respondents were very aware of their IEQ and what factors affected each of them. They had very clear comparisons between previous offices and their current, greener office CS2R<sup>0,4</sup>, CS4R<sup>3</sup> and CS5R<sup>2</sup> felt was that the IEQ contributed to alleviating stresses from both within the office and in their personal lives. Their happier and healthier feeling attributed to their mood and ability to deal with stress. This was in line with the literature whereby Feige *et al.* (2013) and Sullivan *et al.* (2013) state that an enhanced IEQ and a better work environment lead to higher occupant satisfaction.

#### 4.7.2 Productivity

All of the interviewees were aware of their productivity and how certain factors had a greater effect on it. Some of them however admitted that measuring productivity was a more complex concept given the nature of the business. The more creative disciplines require more rigorous methods and attention to measure productivity. All of the case studies reported improved productivity, whether it was how much they were completing or the efficiency with they completed it. CS1R<sup>6</sup> did however say that although there is a higher level of productivity in this office than in the previous office, there was still room for improvement, which could be solved through a few changes to the office environment, but these were personal feelings and not shared with colleagues.

#### Measurement

CS1R<sup>6</sup> used financial metrics to measure productivity. Given the creative nature of the business, the respondent was aware of the difficulty in measuring productivity and thus created metrics to measure both the chargeable and non-chargeable items. The creative

nature also meant that the client's satisfaction would be used as a measurement tool. This relates to (Clements-Croome, 2003)'s measurement of productivity: physiological, objective and subjective. Physiological, looking at measures of activation that are associated with increased activity in the nervous system; objective measures, used to deduce the amount of workload physically and mentally; and, lastly, subjective measures, that look at the occupants' perceptions (Clements-Croome, 2003). CS4R<sup>3</sup> and CS5R<sup>2</sup> both had monthly or project-based timelines attached to their tasks, giving them a strong metric to measure their productivity. CS3R<sup>3</sup> had a mixture of the above two measurements, taking into account stakeholder satisfaction with project timelines and how these were achieved. CS2R<sup>0.4</sup> found it more difficult to apply actual metrics to measuring productivity and based most of the responses on a self-assessed productivity measure.

### *Perceived*

Where respondents were unable to explain metrics for measuring productivity, it was assumed that perceived productivity was being used. Given the subjective nature of the productivity measure, researchers accept self-assessment rather than no measure at all (Haynes, 2008a; Sullivan *et al.*, 2013). CS1R<sup>6</sup> felt more productive in the greener office but was not convinced this was purely due to the green initiatives but also because of a change in management. CS2R<sup>0.4</sup> was very positive about the increase in productivity and said that a difference had been noticed. CS4R<sup>3</sup> was equally positive, stating that the team was working better together since moving to the new, greener office and that employees could maintain the same level of productivity throughout the day, something that was not possible before. CS4R<sup>3</sup> and CS5R<sup>2</sup> were both perceiving their productivity to have improved, although they state they were previously very productive, it feels a lot easier now that the environment has improved. The findings by Newsham *et al.* (2013) validate these responses whereby they state that although both green and non-green offices might have IEQ's that are acceptable, green buildings present a much higher quality internal environment. These measures of productivity all proved to be fairly subjective, and it is thus important to note that all of the measures are self-assessed.

### 4.7.3 Relationship between Green Buildings and Productivity

Based on the findings and the literature, conclusions were drawn on whether the changes in productivity resulted from green initiatives being implemented or other factors and whether these changes were positive or negative. The respondents were asked this

question and the following was found. CS1R<sup>6</sup> stated that the green initiatives in his office had definitely contributed to an improved working environment and helped his productivity but the open plan office had been a disturbance for him, and he would be even more productive in his own office, which as mentioned previously, was a concern of Kato *et al.* (2009). In this case, most of the initiatives were positive, but what was negative for him had quite an impact on his productivity.

CS2R<sup>0,4</sup> reported that in the short time being in this office, there had been a noticeable positive connection between the green initiatives and the working environment, and in turn, increased productivity as expected by Singh *et al.* (2010). CS3R<sup>3</sup> agreed with that sentiment and had noticed a direct difference between the old office and the greener office. The only issue, although far less important than in CS1R<sup>6</sup>, was the noise in the open-plan office. The respondent did however say that the open-plan also helped with the creative environment they were trying to create in the office but needed a private office too.

CS4R<sup>3</sup> was positive about the improved working environment but could not say it was due to the green initiatives that had been implemented. The employers care for the staff's general wellbeing was a huge contributor to the increased productivity, but this included both green initiatives and ergonomic design for each employee. CS5R<sup>2</sup> feels as though the level of productivity is better and the workdays are easier since moving to a green building. CS5R<sup>2</sup> was very productive before, but it came with pressure and stress, whereas the respondent feels better and healthier in the new green building.

Table 4.1 summarises the key information surrounding the relationship between green buildings and productivity. As discussed in Chapter 3, this table has been colour-coded to show similarities and differences in the information. Green was used to show a similar concept whilst red was used to show where the concepts were dissimilar. Where a concept was similar to one but dissimilar to another, a green block was used with red font.

Table 4.1: Cross-Analysis of Green Buildings and Productivity

Relationship between Green Buildings and Productivity				
	Green Buildings		Productivity	
	Green Initiatives	IEQ	Measurement	Perceived
CS1	Not many green initiatives. User control on windows, water saving initiatives, open plan offices, recycling, green position statement.	Good views, natural feeling, good temperature, natural light and ventilation but not always good for work environment. Bad pest control. Good communication but can be noisy.	Looks at financial metrics for project performance. Performance relative to salary. Additionally, metrics for measuring performance on non-chargeable items.	Could be more productive in own office. Increased perceived productivity due to change in environment and change in management.
CS2	Recycling, big windows and blinds lifted and double-glazing. Office culture is to save water, not to use plastic, reduce electricity usage and emphasise sustainability. Green cleaning products, open plan office and many live plants.	Natural light, some air-conditioning used but still heat and noise coming through big windows. Good communication across open plan office. Noticed the improved IEQ which provides some relief to external stresses.	Looks at deadlines and how quickly and efficiently these are achieved. Work changes on a daily basis so it is difficult to have standard measurement.	IEQ was conducive to productivity. The difference and improved productivity were noticed. People are more motivated, healthier, happier and stress has been alleviated.
CS3	Continuously implementing initiatives. Open plan office, big open windows and less air-conditioning. People ring live plants to work, grey water system implemented, light sensors and recycling.	Natural light, air and warmth. High noise levels which can be distracting but allows for good interaction.	Few metrics in place to measure but none of them are directly comparable. Measured through stakeholder satisfaction specifically team and customer satisfaction and whether they get good reviews. They compare project goals based on installation and performance to the timeline set. Also look at KPI's.	Improved productivity, employee happiness and collaboration. Team is working better and seem happier. Although they were achieving KPI's in old office, they have noticed increase in productivity in new office and they can maintain the same productivity all day as they are more motivated.
CS4	Carbon emissions report discussed quarterly, and global consciousness created in the office. Water saving initiatives including water tanks and borehole, recycling, LED energy saving lightbulbs, light motion sensors, energy saving computer screens and double-glazing. Seeds and pips are passed on to be planted in communities. Some green cleaning products, reusable cutlery and crockery. Air-conditioner is kept at a constant temperature and windows are closed. They are discouraged to travel and rather work over calls. Office is open plan.	Very quiet working environment. Where there was glare from outside, it was fixed very quickly. Lots of natural light, good constant temperature and overall improved IEQ.	Measured by how quickly the list of tasks is completed. With projects, they look at full circle and whether timeline was abided by. Performance reviews held throughout the year.	Feels more productive and is achieving goals. Healthier and happier leading to higher productivity.
CS5	Bright, white lighting, air-conditioner kept at constant temperature, open plan office and light motion sensor. Printing system in place to discourage wastage.	Fresh air, natural lighting. Natural and comfortable environment created.	Measured by how quickly tasks are completed. Tasks are repeated monthly so can compare and measure.	Definitely more productive. Feels happier and healthier and therefore works better.

Figure 4.2 depicts the findings of this research whereby an office building is implemented with green initiatives and whilst most of the effects in the IEQ are positive, there are a few that are negative for the occupant, such as glare, noise, and pest control (as with CS1) The mitigation of these by management (as with CS4) allows the employees to benefit from these initiatives entirely. The green initiatives and improved IEQ will lead to green certification. The higher IEQ and acknowledgement of green consciousness will lead to higher occupant satisfaction, which as Haynes (2007b) says, will lead to higher productivity in the office. Higher productivity, especially over time, will lead to higher profitability for the company.

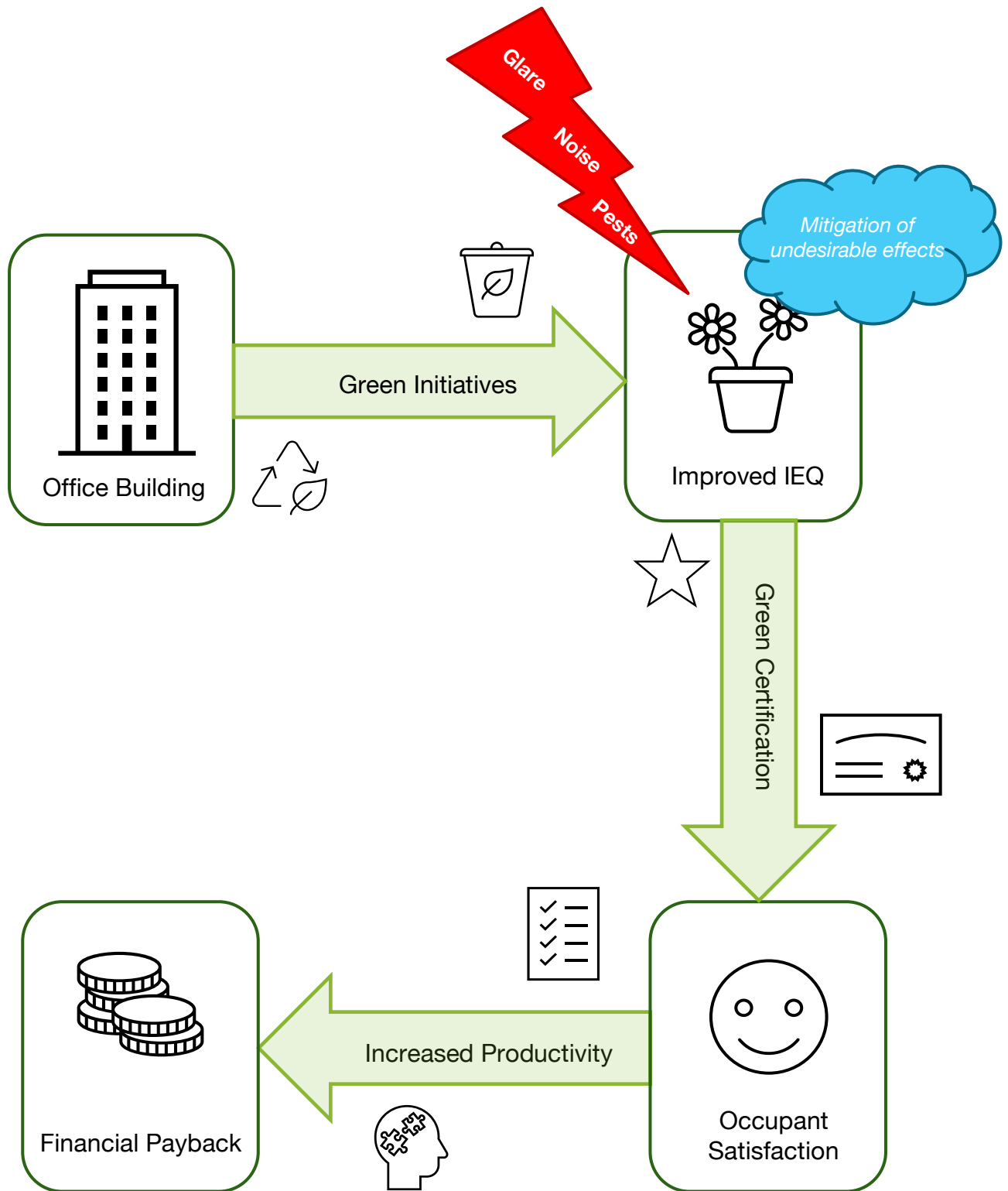


Figure 4.3: The Relationship between Green Buildings and Productivity

## 4.8 Chapter Summary

This chapter aimed to state the findings from the interviews conducted with respondents from five different 4-Star Green-certified buildings in a multiple case study design. With these findings, comparisons were made with information from the literature to support or refute such claims. In addition, cross-case analysis was conducted whereby a comparison was performed across the findings from the five case studies. This highlighted the important similarities between case studies and drew relevant and significant conclusions. These findings are used in Chapter 5, where conclusions are drawn and recommendations for future research are discussed.

# Chapter 5: Conclusions and Recommendations

## 5.1 Introduction

This research study aimed to investigate the relationship between green buildings and their occupants' levels of productivity. This chapter relooks at the research objectives set out in Chapter 1, which then is reviewed against the findings before the proposition is supported or refuted. A conclusion is then drawn. Thereafter, limitations of the study will be discussed, and further research recommendations are suggested.

As outlined in Chapter 1, the problem statement was as follows:

*The relationship between green office buildings and the occupants' levels of productivity is unknown.*

The research question to be answered was as follows:

*What is the relationship between green office buildings and the occupants' levels of productivity?*

The proposition that has been supported or refuted was as follows:

*A positive relationship exists between green office buildings and the occupants' levels of productivity.*

## 5.2 Achievement of Research Objectives

The research objectives of this study were as follows:

- i. Determine the most common green features in office buildings.
- ii. Determine how productivity is measured in an office building.
- iii. Determine occupants' perceptions of the effects of green features on their IEQ in office buildings.
- iv. Assess the occupants of green office buildings' perception of green features on their productivity.
- v. Determine the effect of the implementation of green features on occupants of office buildings.

Objective (i), determining the most common green features in office buildings, was achieved through conducting semi-structured interviews with occupants of green office buildings and relating this to the literature on IEQ. Byrd and Rasheed (2016) identified the seven aspects of IEQ to be (1) internal air quality, (2) temperature, (3) humidity, (4) ventilation, (5) lighting, (6) acoustics and (7) ergonomic design and safety. These aspects were considered when asking the questions to encourage respondents to think about their surroundings (Ries *et al.*, 2006; Miller *et al.*, 2009). In addition to this the researcher was able to observe the IEQ in each office during the interview and study the reports presented by the owner of the building.

From the literature, the researcher was able to draw out key IEQ factors and green features that might be noticeable to the respondent and discuss which of these features were present in the office. This allowed the researcher to determine how green the office was, and which initiatives were effective in the eyes of the occupants. Whilst these buildings were Green-Star Rated, it was important to determine whether the occupants were aware of these features in understanding whether these features had any effect on the IEQ.

Objective (ii), determining how productivity is measured in an office building, was partly achieved through conducting semi-structured interviews. This objective resulted in a very subjective and individual finding. As the literature expressed, certain industries are harder to measure, such as the creative discipline which resulted in the self-assessment of productivity and relying on the individual's metrics (Haynes, 2007e; 2008a; Miller *et al.*, 2009; Sullivan *et al.*, 2013). During the interviews, the researcher posed the question to the occupants about whether they felt more productive and how they measured productivity to say whether or not they do feel more productive. The respondents were able to give clear answers on how they felt more productive and some even had their own metrics to prove it. It was however evident that these measurements were in the majority self-perceived, and the researcher had to rely on their word.

Objective (iii), determining occupants' perceptions of the effects of green features on their IEQ in office buildings, was greatly achieved through the semi-structured interviews. Once the respondents had identified the green features that they were aware of in the building, the researcher could probe into how these were perceived and how it affected their

workspace. Respondents were certain of the effects these had and, whilst most of these were positive, there were a few that respondents pointed out as being slightly disruptive or that could be improved upon. As the literature explained, not all green features are well received by a building's occupants and some can have negative effects on the working environment (Heerwagen, 2010; Thatcher and Milner, 2014). There are suitable measures to reduce the negative effect that these features may have, and each case should be dealt with accordingly.

Objective (iv), assessing the occupants of green office buildings' perceptions of green features on their productivity, was achieved during the interview process as it built on to objective (iii). Respondents were asked to explain how the green features not only affected their environment but further, how it affected their productivity. This allowed the occupants to assess their levels of productivity before and after the implementation of green features and provide feedback on this change.

Objective (v), determining the effect of the implementation of green features on occupants of office buildings, was achieved by looking at the results from objectives (iii) and (iv). Respondents reported majority positive results from the green initiatives that were implemented in the office. Guiding the respondents through the steps of the above objectives, allowed the respondents to assess the impact the green features were having on their work environment, and whether it was overall a positive or negative one.

### 5.3 Findings of the Research Question

The study aimed to address the following research question:

*What is the relationship between green office buildings and the occupants' levels of productivity?*

It is often thought that green buildings are costly initiatives that show little to no financial return for their burden. However, according to the literature and the findings, this is not always the case. Whilst some green features may be costly, many of them return a benefit that cannot be measured in monetary terms initially (Feige *et al.*, 2013; WGBC, 2013a). The payback period may seem extensive if looking at it from an immediate financial payback

point of view, but the benefits were seen in this research from the effect it has on the occupants, and their happiness, health, and resulting productivity (Feige *et al.*, 2013; Sullivan *et al.*, 2013).

Respondents reported feeling happier and healthier when there was natural light, natural ventilation, and an overall improved IEQ. While some of these features had negative side-effects such as pest control and glare, some of the occupants did report that these were solved with other preventative measures. It is important that this is carried out further across the board to maintain a positive perception of green features amongst occupants of green buildings.

The effect that green initiatives have on occupants is more than just a feeling of health and caring for the environment. Occupants believe their company is caring about more than just profit and is making an effort to care for the employees. The overall effect on motivation and thus productivity comes from more than just an improved IEQ.

## 5.4 Support or Refute the Proposition

The research aimed to address the following proposition:

*A positive relationship exists between green office buildings and the occupants' levels of productivity.*

Green office buildings have features that benefit the occupants and their working environment. Whilst there are a few initiatives that need attention, the majority encourages a healthy and happy workspace.

Due to the findings, the proposition is supported, based on the grounds that occupants of green buildings reported improved productivity levels since the implementation of green initiatives. Whilst there were some reservations in the way some of the initiatives were implemented, the majority were reported as positive and beneficial to their productivity levels.

## 5.5 Conclusions

The growing importance of green buildings in the past two decades has led to a need for research into the adoption and benefits thereof (Nurick and Thatcher, 2021). A focus on productivity of employees as a way to improve financial returns is one that has caught the attention of researchers of green buildings. Measuring productivity in quantifiable terms is a challenge, given the subjective nature of the concept (Fisk *et al.*, 2011). Investors need a financial return to justify spending a large amount of money on voluntary initiatives. It thus becomes necessary for researchers to measure self-assessed productivity to explain the relationship that exists between green buildings and increased productivity, resulting in greater financial gain.

This study shows how the adoption of green buildings is not a simple one, requiring much investigation and engagement with the occupants, to improve upon initiatives that may diminish the improved indoor environment quality. A healthier, happier and greener environment has shown an increase in productivity and thus justifies the need for more green buildings.

Therefore, this study has shown that green buildings have a positive relationship with the occupants' levels of self-assessed productivity.

## 5.6 Recommendations for Further Research

- Approach a range of Green-Star Buildings to create a comparison.

A limitation in this research was the fact that only 4-Star Green Buildings were included. A recommendation for future research would be to include and compare 5- and 6-Star Green Buildings. This would give a greater sample to compare and more information on green initiatives implemented to gain a 5- or 6-Star rating.

- Interview more than one occupant per building.

A further recommendation would be to interview more than one occupant per building, to better understand of the specific office and whether there is a consensus or dispute between the occupants. More respondents per building will increase the reliability of the

information collected and measurements for productivity can be cross analysed to ensure a suitable method for that type of company.

- Interview occupants who are involved in the running of the office and thus more knowledgeable about the green initiatives.

Respondents that are involved in the operations or management of the building will have a greater knowledge of the building and the initiatives implemented in the building. This would offer the researcher a more comprehensive and reliable understanding of the building.

- Create a greater discussion around self-assessed productivity.

As the literature discussed, the method of measuring productivity is not straightforward (Haynes, 2007e; 2008a; Miller *et al.*, 2009; Sullivan *et al.*, 2013). There is no clear solution for this as productivity in the office remains a subjective measurement, but it would be recommended that the researcher create a greater discussion surrounding productivity and self-assessed productivity with each respondent and possibly include an interview with a superior who can either validate or dispute the respondent's self-assessment.

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# Appendix 1: Consent Form

## Case Study 1

### INFORMATION SHEET & CONSENT FORM UNIVERSITY OF CAPE TOWN CONSENT TO PARTICIPATE IN A RESEARCH STUDY

**Research Topic:** The Relationship between Green Office Buildings and its Occupant's Level of Productivity

Dear potential participant,

You are invited to participate in a research study conducted by Sian Smith, a Master's student at the University of Cape Town. The research study is supervised by Saul Nurick from the Department of Construction Economics and Management of the University of Cape Town. The results of the research study shall be presented to the Department of Construction Economics and Management in fulfilment of the requirements of the Master's Degree in Property Studies.

Should you have any queries or concerns regarding the research, please feel free to contact me [smtsia003@myuct.ac.za](mailto:smtsia003@myuct.ac.za). The research supervisor, Saul Nurick can be contacted at [sd.nurick@uct.ac.za](mailto:sd.nurick@uct.ac.za).

#### **Purpose of the research study**

The purpose of this study is to gain insight into the perceptions of productivity of those working in green certified buildings, and who possibly worked there prior to it being certified. The aim is to determine how the green certification has impacted their working space and their productivity levels therein. The process will go as follows:

- Identify the perception of productivity in the building prior to green certification
- Identify the stresses the building features may have caused
- Identify the perception of productivity in the building after green certification
- Identify the stresses the building features now cause
- Identify change in location of the occupant prior to certification and now
- Compare the building pre- and post certification.

#### **Procedure**

Your participation in this research study is completely voluntary. Should you volunteer to participate in the research study, we would consult with you in order to agree on a time that would be suitable for a semi-structured face-to-face interview. This interview should take no longer than 10 minutes. Various questions shall be asked that will be used to supplement data obtained from documentation analysis under a case study research setup.

#### **Potential benefits to participants**

Should you request, the research findings will be shared with you.

**Confidentiality**

Every effort shall be made in order to ensure that the subjects are anonymous and the safeguard of any information provided. Confidentiality of all information shall be maintained. The information obtained from the interview process shall be used for this research study only. The raw data obtain from the interview shall only be revealed to individuals directly associated to the supervision and marking of this research study. Should you choose to participate, for ease and flow of the conversation, I would like to request that I may record our conversation. Please note that you will not be required to state your name or position in the company, and this will be kept completely confidential and anonymous. Confidentiality and anonymity will be maintained throughout the research project.

**Participation and Withdrawal**

You may elect to withdraw from this study at any time. You may also elect to refuse to answer any question that you do not wish to answer.


**Rights of research participants**


You may elect to withdraw your consent at any time and discontinue participation without any penalty. This study has been reviewed and granted ethics clearance through the University of Cape Town Research Ethics Board.


**Signature of Research Participant/Legal Representative**

I have read the information above and my questions have been answered to my satisfaction. I hereby agree to participate in this research study and been given a copy of this form.

Thank you for your time,  
Sian Smith

Name of participant .....  ..... Date..... **10.03.2020**

Company of participant  .....

Signature of participant ...  .....

## Case Study 2

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Thank you for your time,  
Sian Smith

Name of participant  ..... Date. 10/03/2020 .....

Company of participant .....  .....

Signature of participant  .....

## Case Study 3

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Sian Smith

Name of participant ...  ..... Date 10/03/2020 .....

Company of participant  .....

Signature of participant  .....

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- Identify change in location of the occupant prior to certification and now
- Compare the building pre- and post-certification.

#### **Procedure**

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Thank you for your time,  
Sian Smith

Name of participant	<div style="background-color: black; width: 150px; height: 20px;"></div>	Date: 22 June 2020
Company of participant:	<div style="background-color: black; width: 300px; height: 25px;"></div>	
Signature of participant	<div style="background-color: black; width: 150px; height: 25px;"></div>	

## Case Study 5

### INFORMATION SHEET & CONSENT FORM UNIVERSITY OF CAPE TOWN CONSENT TO PARTICIPATE IN A RESEARCH STUDY

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Thank you for your time,  
Sian Smith

Name of participant ..  ..... Date..... 10-03-2020 .....

Company of participant .....  .....

Signature of participant ....  .....

## Appendix 2: Interview Questions

1. How long have you worked in this office (years)?
2. Did you work here before the office moved towards green features/certification?

If your answer to 2 was YES, please complete the next section 3, otherwise please move onto question 4.

- 3.1 How long did you work in the office before it acquired green certification (years)?
  - 3.2 Did you feel productive in the office during this time? In what way?
  - 3.3 What components of the indoor environment have contributed to stress levels?
  - 3.4 How did these stresses impact your work life?
  - 3.5 What features of the office did you like and dislike, before green certification (and why)?
  - 3.6 How has your location in the office changed since green certification?
  - 3.7 Has the location affected your productivity? In what way?
- 
- 4.1 What green features do you notice in the office now?
  - 4.2 What features of the office do you now like and dislike?
  - 4.3 Do you feel these features are beneficial to your working environment?

4.4 Do you feel productive and how has your productivity changed since your office has made these changes?

4.5 Explain why or why you do not feel more productive or if you have or haven't proven to be achieving more in the same time frame.

4.6 Are there any components of the indoor environment that help to alleviate stress levels?

## Appendix 3: Interview Transcripts

### Case Study 1 (CS1)

#### CS1 Interview

There are two speakers

**Researcher**

**CS1R<sup>6</sup>** – Respondent

Held on 24th October 2019 at the CS1 offices in Cape Town.

---

**Researcher:** So, I am just going to ask questions according to this guideline as I am doing a qualitative research

**CS1R<sup>6</sup>:** Okay great, let's get started.

**Researcher:** I am going to ask some questions and discuss with you, your take on the building.

**CS1R<sup>6</sup>:** So, what is your topic?

**Researcher:** I am looking at productivity in green buildings; are people more productive, are people spending money on making buildings green and seeing a financial return?

**CS1R<sup>6</sup>:** And the definition of green is this thematic definition of green?

**Researcher:** Yes, and I will try to get a feel for the definition of productivity from you, in this sort of environment and how you guys measure productivity. How would you measure productivity?

**CS1R<sup>6</sup>:** We know exactly how we measure productivity, we have financial metrics that measure project performance and performance relative to salary and performance on non-chargeable stuff; risk work, productive work, final work stage so we have proper systems.

**Researcher:** Do you look per hour and see if a problem arises that is not necessarily being less productive but because of something else?

**CS1R<sup>6</sup>:** It's a bit different because this is a creative discipline so it might take me five minutes to get the concept, but it can also take me 2 months to get the concept but it's the same outcome. So that is when productivity is measured on its financial metric. There are some soft measures later, such as whether it's publication worthy but it's softened in terms of team stuff and that. This is a very interesting topic.

**Researcher:** Yes, it is. So. in this office, when you moved in here, did it have any green initiatives? And how long have you been in this office for?

**CS1R<sup>6</sup>:** 5 or 6 years, and no is the short answer.

**Researcher:** Are there any green features?

**CS1R<sup>6</sup>:** Not much. But here is the point but we moved from a tower and there was a social dynamic to that because that was new management. And what is interesting in terms of vibe is by far the best value. So, there is user control on the windows, and that is probably the only green initiative, it is ridiculous. So, there's not much at all in those standard measures in terms of air quality. I guess the lighting is bad.

**Researcher:** Yes so, I wanted to ask, by having natural light, has that changed anything?

**CS1R<sup>6</sup>:** So yes, it is a nice office because of the street and the views to the South are great and it's in a wind shadow. But that's it. There is nothing green about it. I do a lot of green buildings.

**Researcher:** So, nothing changed when you moved here?

**CS1R<sup>6</sup>:** No nothing changed, we opened a couple of offices here and there?

**Researcher:** And opposed to the other office you worked in that wasn't green?

**CS1R<sup>6</sup>:** The natural ventilation was the difference.

**Researcher:** And you noticed the difference?

**CS1R<sup>6</sup>:** Yes, and the vibe. The truth is, being closer to the ground is better. And productivity is an incredibly difficult thing, organizational changes have been huge in the last 5 years and the building will get lost in the noise. The structure in the organization is completely different.

**Researcher:** What features do you like and dislike?

**CS1R<sup>6</sup>:** We like the views, the air, and we like the vibe and the light.

**Researcher:** Do you use aircon a lot here?

**CS1R<sup>6</sup>:** Not much, a little bit in the summer but it's barely used. We dislike the acoustics because it's shocking and we dislike the flies because that's the thing about natural ventilation.

**Researcher:** Yes, and what about the flow of the office? I see you are sitting in separated offices.

**CS1R<sup>6</sup>:** Yes, it is quite good.

**Researcher:** Do you feel it works or an open office is better?

**CS1R<sup>6</sup>:** No but in terms of productivity it would be far better if I had my own office. I am in the back in an open office. I am always late and rushing home to the children which is bad for people actually sitting and doing work. My staff would be much happier if I wasn't there.

**Researcher:** How much are your stresses affecting your productivity? Or is your happiness or salary affecting your productivity in the company? In comparison to the internal environment quality?

**CS1R<sup>6</sup>:** I would say, satisfaction in terms of quality, as a creative person, we work quite long hours for bad pay. We are clear about that, we don't do it for the money but for the satisfaction of the work and if that's not there, we have failed. The whole things falls off. Pay is second and then environment is after that.

**Researcher:** Do you feel you would be happier in a different environment?

**CS1R<sup>6</sup>:** No this is good. My desk looks up to the tree and the mountain. And when it's open, there is a little stream going there and it can't be beaten; twelve out of ten. So that definitely helps me feel productive. And there has definitely been a big change in productivity since leaving the tower.

**Researcher:** Where was the tower?

**CS1R<sup>6</sup>:** It was the ABSA building, which is now being converted to micro-units.

**Researcher:** How many people work in your office with you?

**CS1R<sup>6</sup>:** In this building, there are 40 but in the back office where I work there are 23 people in the open plan office.

**Researcher:** Do you think the open plan makes it easier for communication?

**CS1R<sup>6</sup>:** Definitely

**Researcher:** And when you put the aircon on and the windows open, it is effective in that space?

**CS1R<sup>6</sup>:** Mixed but there is also the male female problem of who wants what. As with any open plan office.

**Researcher:** Why do you feel more or less productive? Are there specific things that are affecting your productivity?

**CS1R<sup>6</sup>:** Definitely acoustics.

**Researcher:** Is it because there are so many people or because it's an open space?

**CS1R<sup>6</sup>:** It's a hard open space, doesn't matter how many people there are. Across the room it's not too bad but with the density, it is. Better acoustics would be better. There is an irony across user control. We can all control our little desks but if one is not controlling it, then you don't get cross-ventilation.

**Researcher:** Is there a lot of communication happening between users?

**CS1R<sup>6</sup>:** There are a lot of headphones, but there is a lot of two people sitting together designing looking and making decisions together. Open plan with some cellular offices is good. We would need 80% open plan with 20% cellular. The executives still sit in their own offices which is great because they don't want to be with us and we don't want to be with them. But there is a mid-level, my level where I would do well in my own office. It's a productivity and a morale thing, because there are 23 people in the room and if one doesn't understand how I operate, I can be extremely negatively perceived and that now spreads to five or six people now hearing this even though they haven't got a clue what is going on. This has happened once before and we had to correct it. That's the risk.

**Researcher:** Are there things that are used such as recycling?

**CS1R<sup>6</sup>:** Yes, there is actually a green position statement around, that we try to have fuel efficient cars, we do recycle a lot of paper, for maybe five or six years now, we have a conscientious collection of the waste. It's not much more than that. That kind of just happens.

**Researcher:** So, it is not heavily enforced?

**CS1R<sup>6</sup>:** No, it is kind of just done and is set up. It just flows. There is an unbelievable amount of paper waste and that gets managed and properly recycled. The waste management is good, the ventilation is good.

**Researcher:** And the water usage?

**CS1R<sup>6</sup>:** The day zero stuff never really took off in our offices, even though we applied it to our projects. The building management responded extremely well to the day zero stuff, but more in reduction by cutting off the water systems, taking the big flush off of the toilets.

**Researcher:** How did that affect the vibe around here?

**CS1R<sup>6</sup>:** It didn't really. It was a tense time, there was ambient tension. But it didn't add to the tension. There weren't any day zero deniers.

**Researcher:** Is there anything else you can think of that you would consider green in this building?

**CS1R<sup>6</sup>:** So, if I took the IEQ point list, we would have to consider pest control.

**Researcher:** Which wasn't an issue in the tower?

**CS1R<sup>6</sup>:** Yes, it wasn't an issue with no open windows. This is small stuff but it irritates me and I can't be irritated while working. The lift was so hot in the tower, it was 30 floors, which affected my mood and productivity. I got to work hot and sweaty.

**Researcher:** Do you perceive yourself as more productive in this building than in the ABSA building?

**CS1R<sup>6</sup>:** Yes definitely. But again, because of a change in management.

**Researcher:** So what level of management are you?

**CS1R<sup>6</sup>:** There is quite a flat hierarchy, there is executive level then associate level which is me and then there is staff, so middle management. And another note, our Johannesburg office was Green Starred but we don't actually push it anymore here.

## Case Study 2 (CS2)

### CS2 Interview

There are two speakers

**Researcher**

**CS2R<sup>0,4</sup>** – Respondent

Held on 28th October 2019 at the CS2 offices in Cape Town.

---

**Researcher:** I am doing my Master's dissertation on green buildings so I don't know how much you know about the building, but I am going to go through the questions in front of you. It will be more conversational than specific questions.

**CS2R<sup>0,4</sup>:** Okay great.

**Researcher:** How long have you worked in this office and in this building?

**CS2R<sup>0,4</sup>:** So, I only started at this company on the 13<sup>th</sup> of May.

**Researcher:** So ,about 5 months?

**CS2R<sup>0,4</sup>:** Yes 4 or 5 months ago

**Researcher:** Do you know how long the company has been here?

**CS2R<sup>0,4</sup>:** Since 2012.

**Researcher:** And where did you work previously? Not company wise but did you work in a green building or a normal building?

**CS2R<sup>0,4</sup>:** No, it wasn't a green building. I was a facilities manager at the Boulevard in Woodstock. That was the building I worked in for 3 years.

**Researcher:** So, this is quite different, moving here?

**CS2R<sup>0,4</sup>:** Very different, that was corporate, in here I am wearing sneakers.

**Researcher:** What is your role here?

**CS2R<sup>0,4</sup>:** Office manager

**Researcher:** So, what sort of level is that in the company?

**CS2R<sup>0,4</sup>:** I manage the South African region, so all of the offices itself, I do all of the facilities and everything to do with the office, basically but I don't have any staff that report to me so we would have the senior managers and then you have myself so we basically are the same level and then I will have a team leader that I report to which is in Dubai, same as them.

**Researcher:** Okay, great. Did you work here before the office moved to being green?

**CS2R<sup>0,4</sup>:** I don't know if they were green before. Because I see Growthpoint has the certificate, but I am not sure. I know these bulbs are not energy saving. I am not sure what they constitute as being green.

**Researcher:** So, they haven't just gone green since you started working here?

**CS2R<sup>0,4</sup>:** No, it happened before I got here.

**Researcher:** Okay so we will skip that question. What green features do you notice in the office now?

**CS2R<sup>0,4</sup>:** From our side or from the building manager's side?

**Researcher:** Both

**CS2R<sup>0,4</sup>:** They don't recycle, we have our own recycling bins here, however downstairs they don't actually have recycling bins, so all of the dirt actually is distributed into the same drums, so they don't have that. I also see that like I said, the light bulbs are not energy efficient.

**Researcher:** Do you notice anything with the windows or using ventilation?

**CS2R<sup>0,4</sup>:** We generally have both the aircons and natural ventilation coming into the office. There's lots of people that have this thing about air conditioners so we wouldn't necessarily put air conditioners on so we have natural ventilation coming into the office.

**Researcher:** And light?

**CS2R<sup>0,4</sup>:** Natural light. You will see in the office, all of the blinds are up. One of the things I told the building manager is that I want to look at the amount of light bulbs that we have within the office space. That is way too much, I feel that that load is way too much in that space and that can be cut down. It might be LED lights but we can save, we can definitely do something in that space.

**Researcher:** Do you notice anything different green-wise compared to your previous job? Anything specific that stands out here? Any features?

**CS2R<sup>0,4</sup>:** Not necessarily, because I come from a glass building. So, I didn't have all of these blinds and things in the glass building and I had the additional film on the glass so that determined the temperature in the office and things like that whereas this is a solid wall.

**Researcher:** Are there any water saving initiatives in the office? Because of the drought? Anything in the bathrooms?

**CS2R<sup>0,4</sup>:** Here, I don't see that. Obviously where I come from because I had three floors and each floor was like 1800 squares, here I am going with less than 200 squares, maybe

less. Our company is basically needing to be sustainable and we need to do everything that is sustainable. Here I have a plastic bottle and we are not supposed to be doing that. We wouldn't do the dishes for example because we have a dishwasher so we would have two loads for the day. We wouldn't necessarily use one-time plastic; we always have glass. We do our bit for the sustainability and the environment. However, like I said we might be splitting up dirt but downstairs there's no point because it's not really being disposed of in the way it should. We don't run our aircons throughout the night. If we are not here, everything is switched off.

**Researcher:** Do you think the office is quite aware of the green features?

**CS2R<sup>0.4</sup>:** We have to be because of our company, because our company is very big on sustainability. Not that we don't have a choice, but we need to consider the environment. Everything we do, even the bags and things we give to clients, they have to be non-toxic, reusable items. We don't do straws; we don't do things like that. So it's part of our DNA to be like that.

**Researcher:** Not necessarily because the building management is pushing it.

**CS2R<sup>0.4</sup>:** Not necessarily. Because we have even asked, before I started, we had this committee called Booking Cares; that's the people that clean the beaches and all of those kinds of things. And they pushed to have the recycling within the complex; they actually asked if they could encourage. The more people in the complex, the recycling company will come out. Whereas now, if it's only us, they will charge us like R600 to come and fetch it which doesn't make sense whereas we were trying to get everyone involved but it didn't really work. I suppose if your company does not really drive it unfortunately then there's nothing. Because I have the same issue in my Sandton office where we are really doing everything however that building, we are one of the only tenants that splits our dirt. But the company itself has someone that splits the dirt and gets somebody in to come and do all of those things, so they are way more green than we are.

**Researcher:** That's very interesting to hear what the manager does and how it influences the tenants. It's great that you are doing it. Coming back to that, what green features do you like and dislike here?

**CS2R<sup>0.4</sup>:** Natural light has a huge impact because lots of us like to have the natural light coming in, it gives a different stance. I need to explain this to you. So, part of my job and part of the company, is we need to seek a certain tone and environment for the staff because we are not corporate so when you walk into our space you will feel a certain way so you can see the dehumidifiers and these sorts of things because we need to stand behind this, we need to provide this fresh, non-toxic environment and that is why you will see all of blinds are up. There are many times you will see all of our windows open and things like that because we don't believe in all of that clutter and toxic within the office environment. Like our products for example, we use green products, cleaning products and things like that, we try to go for green products instead of the heavy products.

**Researcher:** What green features do you dislike in the building, if any?

**CS2R<sup>0.4</sup>:** Besides the lighting which I feel like it is too much, and we can improve that, I also feel that the air conditioners for that setup on that side, the units that we have there are too powerful for the space so if we cut down on the units, that would mean we are using less electricity and less energy and those things. However, when I started here, I did ask the building managers "are they recycling?". Because remember the aircons condenses and is that water being recycled back into the system because that water can then flush the bathrooms because that is what we had done at our old building where the aircons are connected to the tanks which then recycles the water.

**Researcher:** And the response?

**CS2R<sup>0.4</sup>:** They just didn't get back to me. I don't know if they have Jojo tanks. Because remember if you have Jojo tanks on your premises, you can supply half council water and half Jojo water, so I don't know if that is what they constitute as green because when I started a couple of months ago, who am I when coming from a corporate background, and I said this and that and they said "no we don't do that".

**Researcher:** Do you work in offices that are enclosed or is it open plan?

**CS2R<sup>0,4</sup>:** It's open plan, I will show you.

**Researcher:** Do you like that?

**CS2R<sup>0,4</sup>:** I like it. I came from working open plan.

**Researcher:** So, you like that? The talking and things, because it is open plan, doesn't bother you or anyone? Do you just put in earphones if need be?

**CS2R<sup>0,4</sup>:** Yes, that's the culture of the business.

**Researcher:** So, there is no problem with that and no distractions? Does it add to creativity?

**CS2R<sup>0,4</sup>:** So, the difference with this company, is it is very creative, the space, everything is quick as it is an internet based company so we have to be on top of everything.

**Researcher:** So because of the nature of the business it works?

**CS2R<sup>0,4</sup>:** Yes, it works

**Researcher:** In your more corporate environment, did you find it more difficult?

**CS2R<sup>0,4</sup>:** In the corporate environment, it was a bit difficult because it was dead silence, you could literally hear a pin drop.

**Researcher:** So you couldn't shout across?

**CS2R<sup>0,4</sup>:** I would!

**Researcher:** And how was that received?

**CS2R<sup>0,4</sup>:** People understood my personality.

**Researcher:** And in one office you're putting one aircon on?

**CS2R<sup>0,4</sup>:** Yes, where I was, was big and there were about 20 offices and that took too much electricity and too much current and too much everything and that was not green. In all of our meeting rooms, we have sensors so even though the switch is on the sensors work. We have that feature to save.

**Researcher:** So, do you feel the green features you have in the building are beneficial to the working environment?

**CS2R<sup>0,4</sup>:** Yes, it is but there could be some improvements. I feel that what we currently have is more business relevant than driven from the landlord if that makes sense.

**Researcher:** So it can be improved? And especially by the landlord?

**CS2R<sup>0,4</sup>:** Yes and yes, so you know when people think about sustainability and things, unfortunately the first thing everybody thinks is recycling, because that is always the quickest fix. So if they do something like that, at least it would start boosting up, as small as it is, it has the most impact.

**Researcher:** And it is the easiest thing to do. So for your type of working environment, it works?

**CS2R<sup>0,4</sup>:** It works yes.

**Researcher:** What that is in place at the moment works? Nothing is detrimental to your type of business?

**CS2R<sup>0,4</sup>:** No

**Researcher:** Do you feel productive in this working environment?

**CS2R<sup>0,4</sup>:** Yes

**Researcher:** More productive than your corporate job?

**CS2R<sup>0,4</sup>:** Before, my corporate job was very, I feel this is more relaxed and it's more leisureable (sic) because in corporate, companies don't worry about you, you are just a number. Whereas working for a Dutch company, people consider the individual, the staff, so that is the major difference.

**Researcher:** So, do you feel your productivity has changed since leaving corporate to here, as in do you feel you do more on a daily basis, I know you might be doing different things, than you were in your previous job?

**CS2R<sup>0,4</sup>:** Previously I was very driven because I was working 24 hours. Now I have the difference, that's what. So, I won't say I am being more productive, it's just the level of productivity.

**Researcher:** Do you think the productivity is due to any features in the environment?

**CS2R<sup>0,4</sup>:** Yes, the environment makes a big difference.

**Researcher:** Do you feel the green initiatives are making you more motivated to work at this company?

**CS2R<sup>0,4</sup>:** Yes, because green initiatives are everything. I can only say this because I come from where there were lots of green plants in the environment and one day, they said budget cuts, remove everything and it made a huge impact. I never ever understood the impact of what plants do to staff and it made a huge difference.

**Researcher:** And looking at this office, are these all-real plants?

**CS2R<sup>0,4</sup>:** Yes.

**Researcher:** So, there's another green feature in itself, creating oxygen. Explain why or why not you feel more productive or if you have or haven't proven to be more productive? I know what you have explained already but why do you feel you are achieving more because of these green features?

**CS2R<sup>0,4</sup>:** The difference is, walking into this from the corporate, was a lifestyle change because I was not used to being this calm. I was not used to walking into an environment where people are worried about what the air smelt like. Because it does make a difference. Because the more you come into the office, usually there is chilled music playing, we have the dehumidifiers on, the environment is just extremely different.

**Researcher:** You are coming into natural light and you don't feel like you're leaving in the dark and arriving in the dark.

**CS2R<sup>0,4</sup>:** Yes, you don't feel that.

**Researcher:** Yes, I can see it is an amazing office. From the outside, you have no idea what is going on in here.

**CS2R<sup>0,4</sup>:** But it's funny when drive on the bridge here, you look into the kitchen and see the colours. People look and think this office looks fun, it's clean, it's fresh. And it looks healthy.

**Researcher:** Do you think there are any components of the indoor environment that help to alleviate stress levels?

**CS2R<sup>0,4</sup>:** Yes, the plants make a big difference. This kitchen would be so different without these plants. So, I think it's all about setting that tone, and using the natural elements because we could have had a kitchen here with no windows. It makes a big difference. I will show you our games area where we have no natural light coming in. It's a big difference.

**Researcher:** So, if you're sitting in a dark room relaxing, it wouldn't be the same. This looks like a space where you actually want to go back to work after lunch. What do you define productivity as? In your work? How do you say you are more productive today than you are tomorrow?

**CS2R<sup>0.4</sup>:** My job changes every single day so it's not like I come in every day and this is what I need to do. It's difficult to define productivity in a different sense.

**Researcher:** I know it's a lot easier when there are sales and sales figures. But it's more difficult in a job like yours. I want to see how you would say you are more productive here than if you were at home working in a closed dark room. How would you say you are more productive?

**CS2R<sup>0.4</sup>:** You can see what your deadlines are. Because we are fast paced, so there is always change and things are always changing so things are always different but there's times that you can come into the office and the day goes so quickly because the nice part about being in this office, there is no tension where you feel you are sitting here for four or five hours. There are times in the day when we look and it's 2 o'clock and we are like is that the time? Because you don't believe that you were that productive getting in at 7 or 8 o'clock and here it is already 2 o'clock. You actually forget to take lunch because you are thinking it has only been an hour since you have been sitting here but it's been 4 hours. And that makes a big difference.

**Researcher:** Are there things that, besides environment, from outside, that might affect your productivity? Do you feel that personal things and stresses and things like that affect your productivity?

**CS2R<sup>0.4</sup>:** But that is why, walking into this job, I had six months of being unemployed so I went through my calm and everything so that is why I am in a different place. That is why I am answering these questions as if I am just walking from one job to another. But I see things differently now, so I don't have that stress. If we do have challenges, we don't call it stress, we would just have some "me time", because we have a mediation room. And you'd walk back into the office and you don't feel that.

**Researcher:** Yes, so it is difficult to measure productivity in a creative environment because there is a deadline but no numbers. I am trying to see if there are any personal or social stresses that might affect you.

**CS2R<sup>0.4</sup>:** So that would be that the office is totally fine and then you have a pipe burst so obviously that spikes our stress level but yet because I am doing facilities for ten years, I know how to manage it. So, I know how to bring myself to a calm. Everybody deals differently. But even in this environment, we do have lots of stresses and lots of challenges and lots of KPIs that we need to meet and all of those. But like I said, I do think the environment, the space in which we are sitting in, makes a big difference.

**Researcher:** So, it alleviates all of those personal stresses? And stresses that have nothing to do with the work you are actually trying to complete?

**CS2R<sup>0.4</sup>:** It does

**Researcher:** Okay

**CS2R<sup>0.4</sup>:** And I think everyone is good here at separating their personal from work. It also depends on the management style so that makes a big difference so because nobody is saying “you need to come in and you need to sit at your desk for all 8 hours”. You feel that you’ve had a tough call and you can come to the kitchen and have a cup of tea. It makes a big difference. So, there is nobody that is telling you and controlling your environment.

**Researcher:** If someone said to you “do you work in a green building?”, what would your answer be?

**CS2R<sup>0.4</sup>:** Not really, I don’t think so. Like I said, I think there could be improvements. I am not saying we are not in a green building, but I am also not saying that we are fully green.

**Researcher:** Do you know if the glass is double glazed?

**CS2R<sup>0,4</sup>:** Apparently, they said it is double glazed glass.

**Researcher:** Do you notice the effect and sound?

**CS2R<sup>0,4</sup>:** Yes, it doesn't block out that much sound.

**Researcher:** And heat and keeping it in in the winter?

**CS2R<sup>0,4</sup>:** No. That was a challenge we had in the office but it's also only because of the boards we had up where it was extremely cold in the office. But also, they weren't using the air conditioners so obviously. And also, what adds to that, is all of these naturally exposed concrete. That makes a huge difference. It might be pretty as a design element but reality, is it doesn't really gel.

**Researcher:** So, you used the aircons for both heating and cooling?

**CS2R<sup>0,4</sup>:** Yes.

**Researcher:** And in summer, does the double-glazing help at all to keep the heat out?

**CS2R<sup>0,4</sup>:** We have had a couple of hot days but then we put the aircon on.

**Researcher:** You have to put the aircon on? It's not working efficiently enough to keep the heat out.

**CS2R<sup>0,4</sup>:** No. I don't actually know if this film that is on here is heat resistant. I don't think it is.

**Researcher:** Are there any elements in here that actually cause stress?

**CS2R<sup>0,4</sup>:** I would say that aircon causes stress because one person doesn't like it. But you will never please everybody. You will get this everywhere. I come from an environment where there are individual units and not a centralised unit and so you get people in different

zones that want to be on a different setting but there was no natural or fresh air. The only fresh air that was coming in, was the from the fresh air coming from the air conditioners themselves. There was no window you could open so it is like you are in a condensed space, but it's not condensed because you have that open space. But you will always get somebody that says they are getting cold. But they can put on a jacket. But as funny as we try to make it sound, you are never going to get the balance of it's comfortable. You will feel when you walked into our space, the aircon at the entrance is not on but generally in summer I put it on and for the main reason that when you walk in from the outside, you can feel the air conditioner is on.

**Researcher:** Interesting that you say you felt closed in but you weren't in your previous space. Did you feel claustrophobic?

**CS2R<sup>04</sup>:** No, it was 1800 squares, it was a three-story building.

**Researcher:** So, have you been sitting in the same place in the office since you've been working here?

**CS2R<sup>04</sup>:** Yes.

**Researcher:** And do you move around?

**CS2R<sup>04</sup>:** Yes, generally every quarter they rotate so nobody is ever sitting in the same space and that helps. I think that makes you less despondent.

**Researcher:** Yes, is it the feeling of new office, new space, new productivity?

**CS2R<sup>04</sup>:** Yes.

**Researcher:** I think that is all thank you.

## Case Study 3 (CS3)

### CS3 Interview

There are two speakers

**Researcher**

**CS3R<sup>3</sup>** – Respondent

Held on 29th October 2019 at the CS3 offices in Cape Town.

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**Researcher:** So I don't know how much you already know about why I am here, but I will explain. I am doing a dissertation towards a Masters of Property Studies at UCT and on green buildings. So I am interviewing some occupants of the green buildings. I am going to ask you a few questions and then afterwards, I will tell you what it is all about.

**CS3R<sup>3</sup>:** Okay sure.

**Researcher:** How long have you worked in this office for?

**CS3R<sup>3</sup>:** Three years

**Researcher:** And do you know much about the greening of this building?

**CS3R<sup>3</sup>:** Green buildings are interesting things and I don't know how to classify really. So how green is this building? I can't really tell you that. I do know a little about green buildings. So as far as I can see and as far as my knowledge goes, this is not a very green building.

**Researcher:** Okay, did you work here before the green initiatives were put in place?

**CS3R<sup>3</sup>:** No, so the previous university advertised about their green buildings and it was drilled into us and what they were doing to make the building green and things like that so I have some context about green buildings.

**Researcher:** So they have been putting the green initiatives into this building slowly, but you weren't here when the building was completely "ungreen"?

**CS3R<sup>3</sup>:** Not in this building specifically but in I was in the building next door so it is similar.

**Researcher:** How long did you work in that building?

**CS3R<sup>3</sup>:** Nine years

**Researcher:** Did you feel productive during that time?

**CS3R<sup>3</sup>:** I would say so yes

**Researcher:** In what way were you productive? Were you achieving your KPI's?

**CS3R<sup>3</sup>:** Yes absolutely, achieving KPIs, good reviews so productivity was good

**Researcher:** Were there any components of the indoor environment in that office that contributed to stress levels? Was there anything that made you more stressed?

**CS3R<sup>3</sup>:** Yes it was very dark and stuffy. They had all of these small offices everywhere and it wasn't really open plan so it was stuffy and dark and you did feel lethargic during the day and you could definitely see the effect.

**Researcher:** So you noticed it on a daily basis?

**CS3R<sup>3</sup>:** Yes definitely. You feel like you want to get out, the feeling of being captured so yes absolutely.

**Researcher:** How did that impact your work life and productivity?

**CS3R<sup>3</sup>:** So productivity then goes down as the day goes on really. So two parts, you struggle to wake up because it's dark and it's stuffy and it's not nice fresh air and as the

day goes on you fall asleep a little bit. I know I am ranting a little bit but it is like that, you feel it.

**Researcher:** So what features of the office did you like?

**CS3R<sup>3</sup>:** Before?

**Researcher:** Yes in the previous office?

**CS3R<sup>3</sup>:** No it was a pretty standard office. There was nothing that stood out. It was a typical office environment, the kitchens were nice but there was nothing really nice.

**Researcher:** And dislikes?

**CS3R<sup>3</sup>:** The darkness, the stuffiness. Those are the main things.

**Researcher:** And working in the separate offices?

**CS3R<sup>3</sup>:** Yes separate offices are not conducive to productivity especially in what we do. It wasn't great but especially that kind of environment where it's a close environment and a dark environment as it is, working in a separate office makes it worse. You don't get any human sight either so the human sight is gone and the rest of it's gone as well.

**Researcher:** How has your location affected your productivity, moving from there to here?

**CS3R<sup>3</sup>:** It is much better where it is now.

**Researcher:** When you were there, was it the same company?

**CS3R<sup>3</sup>:** Yes

**Researcher:** What green features do you notice in this office?

**CS3R<sup>3</sup>:** Well, I can tell you what I like more about this office than that one. I'm not sure what classifies as green features. If you look at the natural light coming in here, the heat from the sun that you now get, it's more natural, it's a more natural environment. The light is not as artificial, the temperature is controlled by the environment, not as much aircon. Well we have aircon but it's a more controlled environment. It's also open plan which makes it better.

**Researcher:** What is your role at the company? What sort of level are you in the company?

**CS3R<sup>3</sup>:** Senior management

**Researcher:** So what sort of features do you like in the office? You said the green things but do you like them?

**CS3R<sup>3</sup>:** Absolutely, the open plan office makes a big difference and it helps with interaction and productivity then as well. It has its challenges as you can imagine.

**Researcher:** So just to touch on those challenges, what challenges?

**CS3R<sup>3</sup>:** There are a lot more disturbances. You are no longer on your own law and you have to deal with everyone else. Which is good working as a team but also very bad because when someone is talking about the rugby, you are also listening so you have a lot more distractions.

**Researcher:** And things like the aircon?

**CS3R<sup>3</sup>:** Right yes so because it is open and light is coming in whether you like it or not you have to be mindful of it, you can't just open the blinds anymore because it shines in people's eyes which in the previous office wasn't a problem because you didn't have all of the control over that, especially in somebody else's environment. Noise levels are a lot higher in the open plan office. But you get fresh air and natural light which I think makes a huge difference.

**Researcher:** Is anyone opposed to it and pulls the blinds down and puts the aircon on?

**CS3R<sup>3</sup>:** No no, not really. You can do that but in general people say they like the natural light. What I've noticed is people bringing plants to work which they didn't before because they can put them in the windowsill and the plant can grow. You feel a lot better and more positive because of the environment. Also you feel like nature, or natural things, maybe I should bring a plant in. Other initiatives I noticed are grey water initiatives that we are using. We are not forced to use but at least it is being implemented.

**Researcher:** Any recycling?

**CS3R<sup>3</sup>:** I do seem them making an effort with recycling.

**Researcher:** And is that by the building or by the company?

**CS3R<sup>3</sup>:** By the building

**Researcher:** So do you feel that these green features are beneficial to the working environment on a whole?

**CS3R<sup>3</sup>:** Absolutely. Productivity, employee happiness, collaboration, yes.

**Researcher:** And you personally feel more productive? And do you see your teams being more productive?

**CS3R<sup>3</sup>:** Yes you're overall happier. It's strange in a software development company so people are different, but you see them being happier because of the environment.

**Researcher:** So you have actually noticed people are happier without me actually talking about it now?

**CS3R<sup>3</sup>:** Yes it's a different mood, a different mindset. People are now all of a sudden doing what they didn't do before. They bring plants to work. It's a very positive thing as stressful as the job is, it does help.

**Researcher:** That's great. So do you feel more productive because it's a more natural environment? It's less office-like, 8 until 5, dark rooms?

**CS3R<sup>3</sup>:** Yes it's more natural. Can we do a lot more? Yes absolutely, you can see when you leave the room, the lights are still on. I did notice that it does happen in the bathrooms sometimes which is good.

**Researcher:** Do you have your own bathrooms in this office?

**CS3R<sup>3</sup>:** No so if you come in in the morning and it's dark, the light comes on and I'm sure there's a timer when you leave, it goes off again. The office inside, we still working on that. Our machines are on the whole night and it uses power which I suppose is unnecessary to do so we don't have those measures in place.

**Researcher:** Do you think any of these components you have been talking about, although they make you more productive, do you feel they alleviate stress?

**CS3R<sup>3</sup>:** Yes

**Researcher:** In what way?

**CS3R<sup>3</sup>:** The mindset is now positive and happier. You can see it in employee wellness which has improved, and people are happier and they deal with stress better. I don't want to say it takes stress away, work stress is still there but it alleviates stress. You are in a different mindset to deal with the stress.

**Researcher:** How do you measure productivity in this company? If there are things that stop the project, those aren't in your control but how would you say you are productive on a daily basis?

**CS3R<sup>3</sup>:** A very long answer, there is no simple answer. But customer satisfaction I suppose, team and customer satisfaction. You can see that you know this guy isn't sleeping all day, this guy isn't bringing the team down. So you notice that general satisfaction of all stakeholders involved.

**Researcher:** Do you have goals that people need to reach each day? Or is it more project based?

**CS3R<sup>3</sup>:** More project based on installation, so you can track that so if this guy says he will do it, you can track it. People are meeting their goals, they also now have time to do boxing or table tennis and the work will still get done.

**Researcher:** And it helps that they are doing this and go straight back to work?

**CS3R<sup>3</sup>:** Yes that is why we encourage it

**Researcher:** Do you notice any personal stresses people have impacting your productivity?

**CS3R<sup>3</sup>:** Yes, home stress will always impact your work environment whether you like it or not. So you do notice it.

**Researcher::** Do these green factors alleviate stress that may be office based or home based?

**CS3R<sup>3</sup>:** Yes in a certain way, absolutely. When you are in a natural environment like we are now with the natural light, you feel better. And it does help you deal with the stress or cope with the home or work stress. We, from a generalised perspective, try to bring in other things like you can see, trying to alleviate that stress as well. Getting the guys involved in table tennis or Xbox or boxing or coffee or whatever the case may be, just to get your mind off of it a bit and our vision is to support your home and work life so if you bring your home stresses here then we do try and help you with that as well. It's a positive environment.

**Researcher:** Yes it looks positive

**CS3R<sup>3</sup>:** It leads to better productivity. You do see that in customer satisfaction.

## Case Study 4 (CS4)

### CS4 Interview

There are two speakers

**Researcher**

**CS4R<sup>3</sup>** – Respondent

Held on 31st October 2019 at the CS4 offices in Cape Town.

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**CS4R<sup>3</sup>**: So, what is the purpose of these questions?

**Researcher**: I will explain that to you afterwards, I don't want to influence your answers but rather find out your opinion.

**CS4R<sup>3</sup>**: Okay got it.

**Researcher**: This is for my dissertation, I am focusing on green buildings in Cape Town, office buildings more specifically.

**CS4R<sup>3</sup>**: Okay cool.

**Researcher**: So how long have you worked in this office?

**CS4R<sup>3</sup>**: I have been here for 3 years.

**Researcher**: Okay so three years.

**CS4R<sup>3</sup>**: Yes, since December 2016.

**Researcher**: How long has the company been here?

**CS4R<sup>3</sup>**: Okay so the company has been here since April, May, June 2016 as the company but before that it was a company that was taken over by my current company and they had

been here for about six years before that. I am not entirely sure how long, but definitely longer than five years. But obviously there were big changes, the office was completely refurbished, new employees, etc. So, I can basically give you information from when it became this company.

**Researcher:** Okay great so you didn't work here before it was green? It was completely as it is now?

**CS4R<sup>3</sup>** When I started, it is the same now. Because the green buildings certification that this building got was in October 2016 and it's valid up until this October 2019 so it's valid for the three years so in the three years that I have been here, we have had the four-star rating.

**Researcher:** Have things changed since then? Have there been more initiatives implemented since then?

**CS4R<sup>3</sup>:** Yes, so there are initiatives, they have done the water crisis initiatives obviously with "Day Zero" looming and off of that, and they have still maintained it, in the bathrooms there are two flushers, the larger flusher has been deactivated and still is, on all of the toilets. And then there are two hand basins, one has been deactivated and one that we can still use. And they have changed the water pressure so it used to run to run for a lot longer and a lot stronger, it is now very, very light trickle for a couple of seconds so you kind of do it twice if you really need to rinse but it obviously saves a lot of water. So those are the two things and then they have also got two boreholes on the property that have been installed in the last three years and they have also got the water tanks as well. So water-wise, all the water for the lawn comes from the boreholes and then the water tanks that can sustain for like two days or so.

**Researcher:** And things like the glass in your windows being double glazed, that was already here when you came to this office?

**CS4R<sup>3</sup>:** No, I think the double glazing was done, I'm not entirely sure if that was landlord or if that was us.

**Researcher:** But it was done since you've been here?

**CS4R<sup>3</sup>:** Yes. So in house, in our tenant space, we have done a lot of green initiatives, because as part of the company, I actually am responsible for the carbon emissions data and management so once every quarter, the carbon emissions team has a meeting globally and we discuss any additional initiatives, where we are in terms of our rating, what your score is, your carbon footprint in that period compared to the previous quarter. So, we have that. And internally, we have a lot of green initiatives.

**Researcher:** So, has that been while you have been here, that those have been implemented?

CS4R<sup>3</sup>: Yes

**Researcher:** I am interested in those in your office.

**CS4R<sup>3</sup>:** Okay yes I can tell you about that. So we have got two separate bins, one for throw-aways, consumables and then we have one for plastics with recyclable bags which goes to recycling. All of our LEDs are energy saving and at night everything goes down, except for our emergency lights. Double glazed windows. Obviously aircon is landlord so that's not our thing but we try and keep it all consistent so it doesn't ever have to work harder. Our other little initiatives are our cleaning lady keeps pips and seeds and things and then plants them in her own community so like our avos. We are a very healthy office so all of that goes to Mira. All of our paper, we recycle. We have two recycling bins in the back. It's shredded and then recycled. Anything that we can reuse, that's not confidential, like presentation paper or the plastic backing of a presentation, or stationery that is outdated and we can't use anything, that also goes to the cleaning lady and it goes to schools. We tried at one stage to keep our cleaning products green, so eco-friendly. We failed a little bit in that regard because most of the suppliers that we are allowed to use actually don't have green cleaning products so it's not that easy to do and maintain but we try as far as possible. We only use reusable glass and crockery, no throw-away coffee cups or knives and forks or paper plates. Everything is reusable.

**Researcher:** And if you did bring in throw away cutlery?

**CS4R<sup>3</sup>:** It's a little bit frowned upon. And we also installed two water coolers, so that we don't have plastic water bottles. So that obviously decreases our plastic use as well but we do still order plastic bottles for the odd one who doesn't want to drink from the cooler and for when we have guests. The coolers go back to the plant and get refilled. Our screens, our monitors also have energy saving. So, everything is on an energy saving level.

**Researcher:** Yes very much so, that's great. So then I can continue to ask you how things differed as you didn't work here before the certification but you did work here before all of these things were implemented.

**CS4R<sup>3</sup>:** So the office was set up to be green but then we implemented all of the other little things over the past three years.

**Researcher:** Before all of that, when you started working here in December 2016, how did productive did you feel in the office?

**CS4R<sup>3</sup>:** Yes I don't know if the initiatives have had an impact on my productivity as such but it definitely has an impact on how you feel about your environment. Obviously knowing people are saving. The assistants and I get very upset when the bankers print for no reason and that sort of thing. So when we do comply with what we feel is greener, then you feel better about your space.

**Researcher:** And the double glazing etcetera?

**CS4R<sup>3</sup>:** That was here unfortunately.

**Researcher:** And open windows and less aircon?

**CS4R<sup>3</sup>:** The open windows is just because they had lunch in here. The windows are always closed and their aircon is always on at a consistent temperature. There was something, I am trying to think when I started.

**Researcher:** Do you have open offices?

**CS4R<sup>3</sup>:** Yes, the back is open, but unfortunately, I can't take you to them.

**Researcher:** Was it open when you started working here?

**CS4R<sup>3</sup>:** Yes, all open.

**Researcher:** How do you feel that affects the productivity?

**CS4R<sup>3</sup>:** No I think it's probably got a positive effect. I don't know. It's very quiet in the back. Everyone works and everyone speaks in a decent tone. I think you kind of get used to sound around you. But it's not loud at all. I don't know if it's worth adding, we have an internal system, workstation assessment. So with every new joiner, you do an assessment online of your work space, your chair setup, your screen, is there too much glare, is it high enough, is it low enough, do you have knee ache, back ache, arm ache, elbow ache, do you have headaches, are you aware of the eyecare policy and stuff like that. And then it gives you a result, you're either okay and need to follow these simple instructions by making adjustments to your chair, lowering the glare on your PC, stand up for five minutes every hour, it gives you some guidance or it says actually you are high risk and the company needs to get an ergonomic assessor to come and assess your situation. Which we then do. So a high risk ergonomic assessor will come out and say whether you need a micro desk, or you need a foot stool because your legs are too short or too long, we need to raise your screen, so these are the things that have taken place. They do a full assessment, take photos and send us a report and we procure whatever is needed from that report.

**Researcher:** So, you're getting your productivity as high as possible through comfort.

**CS4R<sup>3</sup>:** Exactly, exactly. So, we, from a green perspective and an ergonomic perspective, as a company as a whole, are quite aware.

**Researcher:** Yes, you're caring for your employee's comfort. So, you're saying you can't feel any difference in productivity from before to being greener?

**CS4R<sup>3</sup>:** Well I definitely feel moving away from where I worked before this where I had a desk and a random chair which I think was a trestle table, was a terrible environment. It was terrible to work in; they had no paper recycling. I had a little box on the side, if it wasn't confidential and I would take it to recycling. I always had back ache or a sore arm. I could definitely tell you that going from an environment that was not ergonomically advanced or doesn't have a good green initiative, definitely has a positive impact on your productivity. Definitely.

**Researcher:** Are there any components of the indoor environment that do contribute to your stress levels? That cause more stress than it alleviates.

**CS4R<sup>3</sup>:** Other than people? No, there aren't.

**Researcher:** So, the lights don't affect you?

**CS4R<sup>3</sup>:** So, when I started here, when these doors are open and the glare comes off of the windows, and if you look at this slit there in the wall, that was quite hectic for me in terms of glare, so I raised it and got anti-glare screen protectors and these lights were lowered so they don't glare because they were behind my screen so they were quite hectic. And we have these shades so if the blinds are open then I can pull down these shades.

**Researcher:** So, there was glare before but that has been changed.

**CS4R<sup>3</sup>:** Yes, that has been changed.

**Researcher:** How did they impact your work life?

**CS4R<sup>3</sup>:** It was just unpleasant to work like that. It caused high strain and a headache, but I raised it and it was sorted out.

**Researcher:** So, yes natural light can cause glare.

**CS4R<sup>3</sup>:** Yes absolutely. So, if you do natural light you need something that takes away the glare. Because when these doors are open and the blinds are open, I have way too much glare coming in from every side.

**Researcher:** So then if you close the blinds, do you have to turn the lights on?

**CS4R<sup>3</sup>:** Yes, but we have special lights, which we can't switch off. Even with the blinds open, my area would be darker. With the blinds just slightly lifted, without direct light, makes a massive difference.

**Researcher:** So, you still have natural light. Before all of these green initiatives were put in, was there anything you particularly liked in the office or didn't like? Anything that stood out for you.

**CS4R<sup>3</sup>:** I don't work in the open plan, so I have never heard that it does phase anyone. I think it works, especially for our banking team because they can't be in their own little offices, secluded and have to walk to interact. They kind of do business and talk to each other without even looking away from their screens. And the investment banking assistants sit sort of directly behind them, so they also need to be able to talk and communicate without picking up a phone or sending an email. And corporate, we have two corporate employees who are seated slightly away from them, so I want to say when they are on the phone, the others don't hear them because the walkway divides them. So, open plan but still slightly separate.

**Researcher:** There's never an argument about the aircon or the blind being closed?

**CS4R<sup>3</sup>:** No, we try and keep it quite constant. There is an aircon on the banker's side. It is actually quite nicely laid out because there is one of these controllers on the assistant's

side, one on the corporate side and then one at the back for the bankers so you can kind of control but that doesn't often get changed, I try to keep that quite constant. These aircons aren't quite like the ones on the wall that blast air. These are very subtle. The room will cool down quite gradually and heat up quite gradually.

**Researcher:** Have you been sitting here at the front for the past three years?

**CS4R<sup>3</sup>:** Yes, but my manager sits at the back, so I am up and down.

**Researcher:** So, you wouldn't say that the location between here and there affects your productivity because you're on your own?

**CS4R<sup>3</sup>:** It does, I am more productive because I am on my own, definitely. But also, because I am on this side, people come this side to have a cup of coffee and chat whereas on that side, no one chats. I often have to say that I am busy. But I do think I am very productive because I am separate.

**Researcher:** And you've mentioned what green features there are in the building, any features that you dislike that have been implemented?

**CS4R<sup>3</sup>:** The slats in the front where the glare came through could have been considered a green feature, but that has been fixed.

**Researcher:** And you do feel that the green initiatives are beneficial to your environment and that it creates community?

**CS4R<sup>3</sup>:** I think so, ergonomically but I think if I look at the employees in the office, everyone is very health conscious, everyone eats healthy food, you don't often see junk in the office. Everyone has got a green conscious or a climate change social kind of conscience. Also, because the company has that drive in them as well so I think if it was the other way where the company didn't care about green initiative and ergonomic welfare, we would definitely be less productive. People are always giving each other flack when they are printing out thinks unnecessarily. I think the green initiatives do have a positive impact on the working

environment. There's nothing that has been done that is ridiculous. They don't say we can't fly because of the fuel consumption for example, because that would really affect business. I am sure there are other green initiatives that can be implemented that would have a negative effect.

**Researcher:** So, there is nothing that they are implementing in the kitchen or bathroom for example that makes the environment unpleasant?

**CS4R<sup>3</sup>:** No, it's the same as the green cleaning products. For me to go and get them, I am going to have to go to an organic, green store and it's going to take time out of my day. It's probably not going to be as effective as the chemical stuff and I know that's terrible to say but it is what it is. So, I am not going to focus too much on that because that is going to change my working environment and productivity because I will be wasting my time. So no, things where it's small change but it's going to have a negative impact on us, it's just going to stay.

**Researcher:** So, what is your role in the company?

**CS4R<sup>3</sup>:** I am receptionist, office administrator and CEO assistant.

**Researcher:** So, what level would that be in the company?

**CS4R<sup>3</sup>:** Assistant level.

**Researcher:** So, you spend most of your time in the office?

**CS4R<sup>3</sup>:** Yes, I don't travel around. There are three assistants and only one travels. Corporate don't often travel. Our bankers travel. Our company does try and limit you, if you can do a video conference, do a video conference. Don't fly or travel or drive. I work eight until five with an hour's lunch and the rest of the time I am here. Monday to Friday.

**Researcher:** How would you measure your personal productivity?

**CS4R<sup>3</sup>:** I have a list of tasks for the day and if I have ticked off most of them then I have been productive.

**Researcher:** So, does it change every day?

**CS4R<sup>3</sup>:** So, I often have a list of to dos but I only get to three of them because by point three, five other things have come up that are now priority over six, seven and eight so yes I think I measure productivity not necessarily on a day to day but once I have taken something full circle. So, whether it's the invoicing that I have started and finished or a project from start to finish. Most of what I do has a beginning and an end. Some of my things are day to day but a lot of it is changing. If it has taken six months to do, then I know I have taken too long.

**Researcher:** That is what I was going to ask, do you have a timeline for these projects?

**CS4R<sup>3</sup>:** Yes you try and set what you want to do by the end of the month or realistically if something is going to take you three months because there are different parties that are going to be involved from a headquarters level then you obviously take that into account.

**Researcher:** Do you think you are more productive here, looking at those goals or productivity measures that you have, than in a building that wasn't green?

**CS4R<sup>3</sup>:** Yes. I think green or ergonomic?

**Researcher:** Yes, more green where there is an environmental consciousness.

**CS4R<sup>3</sup>:** I think yes. I definitely think it has an impact on your health and this office has very low absenteeism from being sick so yes in that regard.

**Researcher:** Yes. It seems the initiatives you have implemented with aircon and natural light definitely has a health benefit.

**CS4R<sup>3</sup>:** Yes, definitely a health benefit and productivity enhancer. In that regard absolutely. If there wasn't double glazing I would definitely feel less productive because I would probably have a headache all day. That definitely does play a role in productivity. I think recycling the paper doesn't impact my productivity but overall the lighting, the double glazing, the fact that we have our carpets done and fumigated through a green company does stop us getting sick so yes in that regard it does have an impact.

**Researcher:** Yes, and doing the paper and recycling, does that not give you sort of good feeling, motivation or satisfaction?

**CS4R<sup>3</sup>:** Yes, definitely.

**Researcher:** And that motivation is good for morale.

**CS4R<sup>3</sup>:** Yes, I think the fact that the company does so much to be green and to be ergonomically healthy, does give you a positive attitude towards your work. You feel like you are being cared for. You give but they give as well which definitely affects your productivity.

**Researcher:** I might be repeating questions, but I just want to make sure we have covered everything. Are there any components of the indoor environment that alleviate your stress?

**CS4R<sup>3</sup>:** Well we don't have a games room or anything but yes, actually there are. We have got a shower room which is there for the purpose of showering at lunch time because bankers work extremely long hours and as a result their assistants work really long hours so I think the company does definitely want everyone to have a work-life balance but given the industry it is not always possible. Which is used often which is great. They are encouraging a healthy lifestyle.

**Researcher:** That is great that there are components of the office that are making you feel healthier but also an encouragement from the company to be healthier. Why do you feel you are being more productive in the same time frame, than you were before in the previous company?

**CS4R<sup>3</sup>:** I think yes, I am completing tasks quicker. I'm not sure if I can relate it to being green.

**Researcher:** No, you don't have to, I want to know how you know you are being more productive?

**CS4R<sup>3</sup>:** My previous job was more assistant based than this job, so nothing ever really has an end, it is a continuation of things all the time. Whereas here everything is very much project based so it is measurable, and we have a very defined performance review process. So, beginning of the year you state your objectives, it's quite detailed, then mid-year, your manager and you sit and see whether you are on track and why or why not, and how to change this. And then at the end of the year you have the final discussion to see if you have reached your objectives. So, it is quite measurable which is great. So, I often go back into my own objectives between mid-year and end of year and see whether I have taken this full circle or not. So, my things are more within the year. We have month to month but those are sort of done. Whereas before there was no performance rating, there was no objective setting unless it was in your own capacity. There is a big difference in management style, there is a big difference in the company setting and the previous company had no structure. There is accountability.

## Case Study 5 (CS5)

### CS5 Interview

There are two speakers

**Researcher**

**CS5R<sup>2</sup>** – Respondent

Held on 9<sup>th</sup> January 2020 at the CS5 offices in Cape Town.

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**Researcher:** Thank you for being here to be interviewed.

**CS5R<sup>2</sup>:** I hope I don't need to know too much about green buildings to answer this.

**Researcher:** You don't need to know that much, it is more just to get an opinion from you. I am going to put this in front of you so you can see the questions but it is going to be more of a discussion.

**CS5R<sup>2</sup>:** Alright.

**Researcher:** I am going to record it if that is okay. I won't use the company name or any personal information. It is just so I don't have to write as we talk.

**CS5R<sup>2</sup>:** Sure.

**Researcher:** I have spoken to the manager and he has given me a lot of information about the building and I know the building as a whole is not green certified, but this office has a lot of green initiatives that have been implemented.

**CS5R<sup>2</sup>:** Okay

**Researcher:** So how long have you worked in this office?

**CS5R<sup>2</sup>:** Two years.

**Researcher:** And did you work here before the green initiatives were implemented?

**CS5R<sup>2</sup>:** No

**Researcher:** What office did you work in previously? Was it a green office?

**CS5R<sup>2</sup>:** No, a very old building, far from green.

**Researcher:** Then I can ask you questions to see if you can see the difference.

**CS5R<sup>2</sup>:** It was also a property company.

**Researcher:** And they weren't in any way, inclined to be green?

**CS5R<sup>2</sup>:** No

**Researcher:** : When you worked in that previous building, did you feel productive? I am not sure how you measured your productivity but did you feel like you were working hard?

**CS5R<sup>2</sup>:** The feeling was a lot different to the feeling I have here. I was there for nine years so it was the same building you see for nine years so this is a newer look for me but also the building was old, the décor was old, everything was old so I definitely feel more productive here than I did there.

**Researcher:** During the time that you were there, did you notice that you weren't feeling productive?

**CS5R<sup>2</sup>:** Yes because you feel sick when you get there and when you leave there you feel fine.

**Researcher:** Where was the building?

**CS5R<sup>2</sup>:** Riebeeck Street.

**Researcher:** Okay and what sort of components of the indoor environment contributed to those feelings of sick or stress?

**CS5R<sup>2</sup>:** I think the lighting, the yellow lighting for me just doesn't put you in a good mood. I like the bright clear white lighting and just the colour palette.

**Researcher:** Were there windows or was it all closed in with lights?

**CS5R<sup>2</sup>:** No, there was windows but no opening windows because we were on the fourteenth floor so you rely on the air con.

**Researcher:** And how did they impact your work life and your productivity?

**CS5R<sup>2</sup>:** You still just do what you need to do but I can definitely feel the difference between the two, how I feel there and how I feel there. You can see the difference and you kind of appreciate what you have now. You think how did I survive there for so long?

**Researcher:** So only as a comparison you can tell?

**CS5R<sup>2</sup>:** Yes, at the time, I didn't know.

**Researcher:** Everyday is a slug and you walk out feeling completely different.

**CS5R<sup>2</sup>:** Yes.

**Researcher:** What did you like about the office? Was there anything you liked about the office?

**CS5R<sup>2</sup>:** No it was just fine.

**Researcher:** : And as you said you disliked the yellow lights and relying on aircon.

**CS5R<sup>2</sup>:** Yes

**Researcher:** And did you sit in offices that were closed or open plan?

**CS5R<sup>2</sup>:** Open plan.

**Researcher:** Did you enjoy that? And it wasn't noisy?

**CS5R<sup>2</sup>:** Yes and no, you get used to it and you block out certain people. We have got open plan here as well.

**Researcher:** And how do you feel about that here? The same?

**CS5R<sup>2</sup>:** Yes it's fine

**Researcher:** And do you all share the same air con? Is someone in control of the air con?

**CS5R<sup>2</sup>:** The full building air con is controlled by the VMS

**Researcher:** So if it's too cold, you can't change that.

**CS5R<sup>2</sup>:** Yes that's not something we can change on the side, we have to phone the building managers and then they need to get the technicians out but even then it's automated. And it's controlled throughout.

**Researcher:** So do you feel comfortable?

**CS5R<sup>2</sup>:** Yes and if we need a bit more air, then our windows can open. The guy behind us often opens up a window or two. He has a fan on him, he has his window open because he is a hot person but then we get the breeze as well. But generally the temperature is fine.

**Researcher:** So, you were in open plan before so you can't say it affected your productivity.

**CS5R<sup>2</sup>:** No.

**Researcher:** What green features do you notice in the office here?

**CS5R<sup>2</sup>:** The lighting, we have got the savers so if we are sitting in the boardroom for too long and you are sitting still then the lights go off. And the motion sensor will make the lights go back on. That's the one thing and I know it's in our offices and I don't know what the rest of the building has.

**Researcher:** Is there anything else you have noticed in your office?

**CS5R<sup>2</sup>:** We have got the recycling on the floor, in the kitchen for paper, for glass and then for waste and then obviously in the offices inside, we have got the paper recycling.

**Researcher:** Are there things in place to reduce printing?

**CS5R<sup>2</sup>:** Yes, everybody is conscious because you print with your code so you know there is a report that can be pulled but everybody is conscious to not print. And then I also recycle my paper so if I print it and it's wasted paper, then I would keep it and use it for my notes and things and then chuck it. So I can use the other side of the page. So that I brought with me from where I used to be. They all thought I was weird when I did it and now they ask me for some paper so they can make notes on a bigger page than the sticky note or the paper that is in the cube. So I keep that in front of me and I make notes if I am on the phone or I am checking something then I can quickly just write it down and when I'm done I just chuck it.

**Researcher:** And with the natural lighting, do you notice that that impacts your work?

**CS5R<sup>2</sup>:** No it's nice but I can't say I noticed a difference or impact. It's just nicer. It's the natural light, it's the white light. And it's a big open plan office, there's big space between

everybody. We are not sitting on top of each other. Even though there are fake plants, we have got the greenery. Our desks are wide, so it's a nice, clean environment.

**Researcher:** Are there any real plants?

**CS5R<sup>2</sup>:** Inside the office?

Researcher: Yes

**CS5R<sup>2</sup>:** No only when it is somebody's birthday and we bring it in. They last quite long. You can go more than a week with having the plants inside the office or flowers if you get.

**Researcher:** Is there anything that you dislike in this office?

**CS5R<sup>2</sup>:** No, it's perfect

**Researcher:** So everything you have said is beneficial to your work environment, is beneficial to being productive?

**CS5R<sup>2</sup>:** Yes and to how you feel when you come to work, how you feel when you leave here. It's just a breeze.

**Researcher:** That's very good to hear. And so you say those have also affected your productivity from your previous location?

**CS5R<sup>2</sup>:** Yes

**Researcher:** How do you measure your productivity? Are there goals that you set?

**CS5R<sup>2</sup>:** Well I am a property manager so there are certain things that we must get through in a month and they are time-based so now we are busy with budgets but then for one week of the month, we have got projections so you can't do your projections before the time; it opens up for everybody on the same day and it closes for everybody on the same

day. So you work at your own pace but you know you've got that bracket to work in and then after that you kind of get out on the road and do your building visits and things and do all your emails and any kind of queries that come and then you kind of just preparing again for the next projection. So you work month to month with that timeline in mind so you kind of do everything to clean up your stuff before the system opens so you don't have to do too much in that week.

**Researcher:** So, if you finish that you know you have reached your goal?

**CS5R<sup>2</sup>:** Yes, you can sit back and relax and get out on the road and go and visit your tenants, look at your buildings and then come back and start all over again.

**Researcher:** So, you have goals basically all of the time and if you're completing them you know you've been productive?

**CS5R<sup>2</sup>:** Yes, and now is budgets and mid-March with timelines and things like that.

**Researcher:** So, do you feel you are achieving goals quicker and that you could say you are more productive than the last office or is that a different job or more efficiently?

**CS5R<sup>2</sup>:** No, I think I did a bit more where I was before and I achieved it because the pressure was always there. There was a lot more pressure in my previous job but I am a driven person so I can work under pressure so here I don't feel as much pressure as I did before. Maybe that also contributes to why I feel positive in this space than in the other space.

**Researcher:** But you say that you feel better, health-wise and happier?

**CS5R<sup>2</sup>:** No definitely, happier, more comfortable which is probably why I feel more productive, but I did more at the other place than I do here, but I feel more productive here than I did there. It was constant stress and churn on the other side.

**Researcher:** Do you feel there is there anything in this office that is the main contributor to alleviating your stress, when things are pressured?

**CS5R<sup>2</sup>:**No there is nothing particular that I can pin down.


**Researcher:** Nothing that if you went to another office that would be a deal breaker?

**CS5R<sup>2</sup>:** No, I think I am adaptable.

**Researcher:** Okay thank you for your time.

## Appendix 4: Ethics Approval Form

UCT Ethics in Research

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Project Title	<b>The Relationship between Green Office Buildings and its Occupant's Level of Productivity</b>	05/10/2019
	by <b>Sian Smith</b> in <b>EBE Construction Economics Submissions</b>	id. 13093041
	smtsia003@myuct.ac.za	

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**Original submission** 05/10/2019

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Cover Letter	<b>The research aims to determine the relationship between green buildings and their occupants level of productivity. It will involve interviewing the occupants of a green office building to determine their perception of productivity before and after green certification. As the interview is semi-structured and possibly recorded, consent is required in a signed form. This form has been included. The interview is non-invasive and does not require any personal information. The information will however remain anonymous and confidential.</b>
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Application Checklist	<b>Read the EBE Ethics in Research Handbook before completing this application Questionnaire to be used in the research (where applicable) Consent form where (where applicable see Addendum 2)</b>
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Researcher(s)	<b>Sian Smith</b>
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Department	<b>Construction Economics and Management</b>
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E-mail	<b>sian@thornaby.co.za</b>
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Status of Applicant	<b>Student</b>
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Degree Being Studied (For Students Only)	<b>MSc Property Studies</b>
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Name of Supervisor (For Students Only)	<b>Saul Nurick</b>
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Review Track	<b>Normal</b>
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Motivation for an Expedited Review	n/a
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Signature  
[Signature\\_Form\\_-\\_Ethics\\_Approval\\_-\\_Sian\\_Smith.pdf](#)

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SECTION 1: n/a  
Overview of ethics  
issues in your  
research project

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Question 1: Harm to **No**  
Third Parties

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Question 2: Human **Yes**  
Subjects as Sources  
of Data

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Question 3: **No**  
Participation or  
Provision of  
Services To  
Communities

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Question 4: Conflicts **No**  
of Interest

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**If you have answered YES to any of the above questions, please ensure that you append a copy of your Research Proposal (Addendum 1), as well as any interview schedules or questionnaires and consent documentation (Addendum 2) and complete further addenda as appropriate.**

**I hereby undertake to carry out my research in such a way that:**

- 1. there is no apparent legal objection to the nature or the method of research; and**
- 2. the research will not compromise staff or students or the other responsibilities of the University;**
- 3. the stated objective will be achieved, and the findings will have a high degree of validity;**
- 4. limitations and alternative interpretations will be considered;**
- 5. the findings could be subject to peer review and publicly available;**

**and**

- 6. I will comply with the conventions of copyright and avoid any practice that would constitute plagiarism**

ADDENDUM 1 n/a  
Supporting  
documents

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Research Proposal

[Dissertation\\_Proposal\\_-\\_Sian\\_Smith\\_-\\_Ethics\\_Approval.pdf](#)

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ADDENDUM 2 To be completed if you answered YES to question 2 in section 1

It is required that you read the [UCT Code for Research involving Human Subjects](#) in order to be able to answer the questions in this addendum.

Ethical research should safeguard the interests of society and the welfare of all who participate in the research, be they individuals or groups. In this section the researcher is asked to consider the implications of their research on participants in the research. The researcher should outline risks that participants will face by being involved in the research.

When a research involves vulnerable people, a researcher is expected to obtain informed consent from participants. This informed consent should be signed by the participants. Informed consent is intended to protect the interest of both participants and the researcher should something go wrong or should conflict arise between the researcher and the participant.

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Question 2.1: Discrimination	<b>No</b>
Question 2.2: Participation of socially or physically vulnerable people	<b>No</b>
Question 2.3: Informed consent	<b>Yes</b>
Question 2.4: Confidentiality	<b>No</b>
Question 2.5: Anonymity	<b>No</b>
Question 2.6: Risks of physical, psychological or social harm	<b>No</b>
Question 2.7: Payments and giving of gifts	<b>No</b>

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Interview Schedule  
[Interview\\_Schedule\\_-\\_Ethics\\_Approval\\_-\\_Sian\\_Smith.pdf](#)

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Consent Form  
[Ethics\\_Approval\\_-\\_Consent\\_Form\\_-\\_Sian\\_Smith.pdf](#)

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Additional Comments	<b>A consent form will be sent to potential respondents before the interview is scheduled. All of the information has been clearly stated in this form and the interview will be conducted with those who sign it.</b>
ADDENDUM 3 To be completed if you answered YES to question 3 in section 1	<b>Research may sometimes interfere with the organization, progress or advancement of communities. In this section the researcher is asked to consider the effect of their research on a community or communities involved in the research. Attention should be paid to whether the research will disrupt or interrupt the normal activities of the community and how the research will influence communities in the long term.</b>
Question 3.1: Community participation	n/a
Question 3.2: Termination of economic or social support	n/a
Question 3.3: Provision of sub standard services	n/a
Additional Comments	n/a
ADDENDUM 4 To be completed if you answered YES to question 4 in section 1	<b>A conflict of interest may compromise the conduct or outcome of a research project. It may also infringe on the interests of other researchers. In this section the researcher is asked to consider if their research may be compromised by the inclusion of certain individuals or groups in the research. The researcher is also asked to consider whether the inclusion of certain individuals or groups in the research will compromise the research of others at the university. For example, if any participants in the proposed research project are also involved in other projects at the university, have you considered if this participation will negatively affect their work?</b>
Question 4.1: Conflicts of interest	n/a
Question 4.2: Sharing of information	n/a
Question 4.3: Conflict of interest with other research	n/a
Additional Comments	n/a