

UNIVERSITY OF THE WITWATERSRAND

IDENTIFYING THE CONTEXTUAL BARRIERS AND OPPORTUNITIES PERTAINING TO THE
SUSTAINABLE REFURBISHMENT OF EXISTING PUBLIC SECTOR OFFICE BUILDINGS IN THE
INNER CITY AREA OF JOHANNESBURG, SOUTH AFRICA.

A research report presented

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ABSTRACT

In most cases refurbishment is driven by cosmetic upgrade requirements. The existing building stock possesses significant opportunity to improve building performance and reduce its negative impacts on the environment.

The local green building environment in the public sector is analysed. The focus is existing office buildings. The relevant policies and frameworks related to sustainable development is collated and policy objectives are identified and discussed. The research approach adopted is that of a case study method. A comparative case study approach is selected for this study. Key themes emerged from the literature review and these themes informed the semi-structured interviews that took place with the appropriate stakeholders involved in the cases. Three different types of case studies were identified and documented. Comparative case studies emphasise comparison within and across contexts. They involve the analysis and synthesis of the similarities, differences and patterns across two or more cases that share a common goal. The cases were compared, success factors are assessed and findings presented.

A conclusion is presented based on these key themes. Refurbishment of existing buildings is considered the most sustainable response when considered against other activities in the built environment. A single case type of the three selected, the PPP model, emerges as the preferred type offering the greatest potential supporting the sustainable refurbishment of existing public sector office buildings.

EXECUTIVE SUMMARY

The current refurbishment of the existing government owned building stock in South Africa is not necessarily yielding improved sustainable building performance as in most cases it is meant to be cosmetic upgrades. This has led to a situation where the existing building stock is continuously lagging behind in terms of sustainable building performance even after refurbishment. This study seeks to identify the contextual barriers and opportunities pertinent to the sustainable refurbishment of existing public sector office buildings in Johannesburg, South Africa. The existing building stock possesses significant opportunity to improve building performance and reduce its negative impacts on the environment. The study is limited to existing public sector office buildings in the inner city area of Johannesburg, South Africa.

Over their lifecycle, construction projects consume significant resources and contribute to the transformation of cityscapes, urban and rural landscapes. As a result, construction projects have significant impacts on the environment, human health as well as economic consequences (ISO, 2008). The Green Building Policy Draft 3 also refers to environmental sustainability, social sustainability and economic sustainability being the three components of sustainable development (Nordic Innovation, 2014, Department of Public Works, 2014). Renovation of buildings generally refers to improving the performance of the existing building ranging from middle to major renovations. Sustainable renovation refers to a holistic consideration where social, environmental and economic aspects are encompassed in a balanced way (Nielsen, *et al.*, 2016).

The total building stock in South Africa can be expected to double by 2050 based on historical trends and anticipated government investment programmes. If nothing is done to address carbon dioxide(CO₂) emissions this would result in a twofold increase in emissions (Milford, 2009). Several countries worldwide consider sustainable refurbishment to be an effective approach to reducing the carbon dioxide emissions from the existing building stock (Moschetti & Brattebø, 2016) (Masrom, *et al.*, 2017). Our existing building stock is largely inefficient in terms of building performance (DPW, 2014) and a study by United Nations Environment Program – Sustainable Buildings and Climate Initiative (UNEP-SBCI) indicates that even considering likely scenarios of energy efficiency measures, the annual greenhouse gas emissions from existing buildings will still exceed that of new buildings in 2050 (UNEP-SBCI, 2009) therefore, sustainable refurbishment offers the best opportunity to improve the performance of the built environment. There is potential for an existing building's performance to be improved considerably more than its original state.

Public sector buildings are classified within the commercial sector and form the largest part of the total building stock in South Africa. The total building stock in South Africa is estimated at 50.2 million square meters. The estimated value is between R250 and R500 billion (DPW, 2016). Growing a green economy has been identified as a means to achieve the vision of the Gauteng Department of Infrastructure Development (GDID). This strategy to grow the green economy is called, The Green Agenda, and comprises three programs that are expected to make the biggest impact in the province; rooftop solar panel rollout, resource efficiency retrofit (energy and water) and natural gas programs.

The research approach adopted is that of a case study method. Yin (2009) defines a case study as “an empirical inquiry that investigates a contemporary phenomenon in depth and within its real life context especially when the boundaries between phenomenon and context are not clearly evident”. According to Merriam (2009), case studies are anchored in real life situations. A case study approach results in a rich and holistic account of a phenomenon. It expands the researcher’s experiences by offering insights and highlighting meanings. The insights could lead to future research, consequently the case study research method plays an important role in advancing a field’s knowledge base (Merriam, 2009). Case study research uses quantitative or qualitative research and often adopts a mixed method approach to fully understand the dynamics of the case (Saunders, *et al.*, 2016).

The aim of the study is to identify the contextual barriers and opportunities pertinent to the sustainable refurbishment of existing public sector office buildings in South Africa. The case study approach allows the researcher an empirical inquiry that investigates the refurbishment processes in depth and within real life contexts in different scenarios and cases. The case study approach will allow for rich and holistic accounts of the interactions between stakeholders and factors that influence decisions during the refurbishment of existing buildings (Saunders, *et al.*, 2016). These interactions and influencing factors can then be analysed across cases and yield contextual barriers and opportunities pertinent to the sustainable refurbishment of existing buildings.

Three different contexts were identified for analysis; leased buildings occupied but not owned by government, buildings occupied and owned by government and government-owned buildings that are to be refurbished through a public private partnership model.

Key themes that emerged from the literature review included;

1. The descriptions and extent of typical refurbishments. Cosmetic refurbishments include those projects where building finishes and fittings are replaced and these are not intended to yield improved building performance.
2. The refurbishment process varies from project to project and this is also dependant on the extent of refurbishment as well as the expected results or outcomes.
3. There is a lack of uniformity in the manner in which the brief is developed. The non-conformity is largely due to the varying expectations as well as the type of building and stakeholders involved. The owner of a building driving the refurbishment process will have a greater influence on the process when compared to a tenant in a leased building.
4. The key areas for improvement also vary per project.
5. There is an elusiveness of brief adherence that is apparent.
6. A noted enhancement of performance where stipulated in the brief.
7. Instances where the refurbishment falls short of encompassing the three major facets of sustainability; social, economic and environmental.

8. The lack of systematic classification of building performance affects the manner in which building performance is reported.

These themes informed the semi-structured interviews which primarily linked to the three contexts described above. The case studies included:

1. The Kopanong Precinct (government owned buildings Public Private Partnership project)
2. The Corner House (government owned building)
3. Pritchard Street (government leased building)
4. 6 Hollard Street (government leased building)

Interviews with key individuals with some being able to comment on the case studies included:

1. Chief architect GDID
2. Architect at The Green Technologies Unit GDID
3. Environmentalist at The Green Technologies Unit GDID
4. Voluntary association executive
5. Private architect and project management consultant

The interviews were recorded and documented, with a summary provided at the end of each interview. A cross case analysis was conducted which contained and yielded barriers and opportunities pertinent to the sustainable refurbishment of existing public sector office buildings in Braamfontein. A conclusion is presented based on these key themes and recommendations are made. Key concepts at the conclusions and recommendations include;

1. the PPP model type has the greatest potential for improved building performance considering the social, economic and environmental facets of sustainability
2. a particular focus on the social aspect of sustainability
3. a focus on occupant comfort and well-being, thermal and acoustic systems and solutions
4. adopting and adapting successes at healthcare and education sectors where possible,
5. product longevity and Life Cycle Assessments (LCA)
6. the need for the pending legislation, waste separation and recycling initiatives linked to awareness, education and behavioural change required
7. the manner in which products should be delivered, possible effects on well-being and productivity post refurbishment
8. the impact of Building Information Modelling (BIM) and City Information Modelling (CIM) on sustainable development and sustainable refurbishment of existing buildings.

DECLARATION

I, **Sathia Govender**, declare that this research report is my own work except as indicated in the references and acknowledgements. It is submitted in partial fulfilment of the requirements for the Degree of Master of Science in Building in the University of Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.

Having Studied the “guideline for examination of a Master’s dissertation” issued by the University of Witwatersrand together with a copy of this dissertation, I declare that this report submitted by me has been compiled individually and independently by me.



Signed at MIDRAND, JOHANNESBURG

On the 26th day of AUGUST (year) 2019

DEDICATION

This study is dedicated to my phenomenal wife Nicolene and our precious children, Sienna Nicole and Nataniel Saths. They are my inspiration and my reason.

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Table of Contents

ABSTRACT	i
EXECUTIVE SUMMARY	ii
DECLARATION	v
DEDICATION	vi
ACKNOWLEDGEMENTS	vi
1. List of Tables	xiii
2. List of Figures	xiii
3. List of Acronyms	xiii
4. List of Definitions	xv
Chapter 1: Introduction	1
1.1. Background	1
1.2. Context of the study	1
1.3. Problem Statement	2
1.4. Research Question	3
1.4.1. Sub-questions	3
1.5. Aim	3
1.6. Research objectives	3
1.7. Significance of the study	3
1.8. Scope of the study	4
1.9. Delimitations and limitations of the study	4
1.10. Structure of the Report	5
1.11. Summary	6
Chapter 2: Literature Review	7
2.1. An introduction: the effects of construction works	7
2.2. Defining Sustainable Development	7
2.3. Sustainable or Green Buildings	10
2.4. Refurbishment of existing buildings: Global context	10

2.5.	Refurbishment of existing buildings: The South African context	12
2.6.	The existing buildings potential	13
2.7.	Legislation & Standards	15
2.8.	The Green Building Council of South Africa	16
2.9.	Technology, well-being, occupant comfort	17
2.10.	Drivers & Opportunities	18
2.11.	Gaps and challenges identified	18
2.12.	Summary	20
Chapter 3: Status of the current building stock vis-a-vis the main tenets of green building performance in the public sector: literature survey		23
3.1.	Context	23
3.2.	The Green Agenda	23
3.2.1.	Rooftop Solar PV Rollout Programme	24
3.2.2.	The Resource Efficiency Retrofit Program	24
3.2.3.	Other potential opportunities	25
3.3.	Summary	25
Chapter 4: Policies and frameworks pertinent to sustainable development of the built environment for both new and existing buildings: literature survey		26
4.1.	Introduction	26
4.2.	DPW Green Building Policy	27
4.3.	Post 2015 National Energy Efficiency Strategy – first draft March 2016	28
4.4.	SANS 1544 Energy Performance Certificates for buildings – Draft 1	30
4.5.	SANS 10400 XA	32
4.6.	SANS 204	33
4.7.	Green Building Norms & Standards WP3: Existing Buildings - Draft 2	34
4.8.	Maintenance Management Standard National Immovable Asset Maintenance Management	35
4.9.	Maintenance Monitoring and Evaluation Protocol	36
4.10.	National Climate Change Response White Paper	36

4.11.	Summary	37
Chapter 5: Research Methodology		38
5.1.	Introduction	38
5.2.	Case study approach	38
5.3.	Case study strategy	39
5.4.	Research philosophy	40
5.5.	Theoretical perspectives	41
5.6.	Modernism and postmodernism in research	42
5.7.	Data collection	42
5.8.	Data Analysis	44
5.9.	Identification of themes.....	45
5.10.	Sampling in research	46
5.11.	Validity and Reliability.....	47
5.12.	Ethics in Research	48
5.13.	Summary	49
Chapter 6: Case Studies		50
6.1.	Case Study 1: The Kopanong Precinct.....	50
6.1.1.	Introduction	50
6.1.2.	Project description	51
6.1.3.	Project scope.....	52
6.1.4.	Profile of the respondents	55
6.1.5.	Semi-structured interviews.....	55
6.1.14.	Addressing the research objectives	58
6.1.15.	Summary	60
6.2.	Case Study 2: The Corner House.....	62
6.2.1.	Introduction	62
6.2.2.	Project description	63

6.2.3.	Project scope.....	63
6.2.4.	Profile of the respondents	64
6.2.5.	Semi-structured interviews.....	64
6.2.14.	Addressing the research objectives	66
6.2.15.	Summary	68
6.3.	Case Study 3: Pritchard Street	69
6.3.1.	Introduction	69
6.3.2.	Project description	70
6.3.3.	Project scope.....	71
6.3.4.	Profile of the respondent.....	72
6.3.5.	Semi-structured interviews.....	72
6.3.14.	Addressing the research objectives	73
6.3.15.	Summary	75
6.4.	Interview with Chief Architect & Case Study 4 – 6 Hollard Street & Kopanong Precinct.....	76
6.4.1.	Introduction	76
6.4.2.	Project description	76
6.4.3.	Project scope.....	76
6.4.4.	Profile of the respondents	77
6.4.5.	Semi-structured interviews.....	77
6.4.14.	Addressing the research objectives	84
6.4.15.	Summary	86
6.5.	Interview with voluntary association built environment expert	88
6.5.1.	Introduction	88
6.5.2.	Project description	88
6.5.3.	Project scope.....	88
6.5.4.	Profile of the respondent.....	88
6.5.5.	Semi-structured interviews.....	88

6.5.14.	Addressing the research objectives	91
6.5.15.	Summary	92
6.6.	Interview with an architect and an environmentalist at GDID Green Technologies Unit	94
6.6.1.	Introduction	94
6.6.2.	Project description	94
6.6.3.	Project scope.....	94
6.6.4.	Profile of the respondents	94
6.6.5.	Semi-structured interviews.....	94
6.6.14.	Addressing the research objectives	97
6.6.15.	Summary	98
6.7.	Interview with private practice MD for an Architecture and Project Management consultancy	100
6.7.1.	Introduction	100
6.7.2.	Project description	100
6.7.3.	Project scope.....	100
6.7.4.	Profile of the respondents	100
6.7.5.	Semi-structured interviews.....	100
6.7.14.	Addressing the research objectives	102
6.7.15.	Summary	103
Chapter 7:	Cross case analysis	105
7.1.	Analysis and findings.....	105
7.2.	Analysis of the semi-structured interviews	105
7.3.	Summary	109
Chapter 8:	Conclusions and recommendations.....	110
8.1.	Introduction	110
8.2.	Summary of the Study	110
8.3.	Conclusions	112
8.4.	Recommendations	113

8.5.	Directions for future research.....	114
9.	Bibliography	116
10.	Appendices.....	123
10.1.	Appendix 1: Semi Structured interviews.....	123
10.2.	Appendix 2: UNABRIDGED - Cross case study analysis. Conclusions and recommendations.....	124

1. List of Tables

Table 1. Improvements in energy intensity (2000-2012) compared to the 2005 targets.....	1
Table 2. Total public sector building stock	Error! Bookmark not defined.
Table 3. The way forward	29
Table 4. Measures to be implemented	30
Table 5. SANS 10400 XA and SANS 204 requirements.....	33

2. List of Figures

Figure 1. Format of the energy performance certificate (SABS, 2014).....	32
Figure 2. Aerial location view of Kopanong precinct	51
Figure 3. Aerial view of the precinct. See Figure 4 for building names.	52
Figure 4. Aerial view with building names at the Kopanong precinct	53
Figure 5. Vertical profile of precinct buildings.....	54
Figure 6. Constructed area of precinct buildings.....	55
Figure 7. 63 Fox Street. Google map view	62
Figure 8. View toward The Corner House from Pixley Ka Isaka Seme Street looking north.....	63
Figure 9. Corner of Pritchard and Joubert Streets. Google map view	69
Figure 10. Corner of Pritchard and Joubert Streets. Looking South West.....	70
Figure 11. 78 Fox Street.	71
Figure 12. Corner of Helen Joseph and Joubert Streets. Looking North West	71
Figure 13. 6 Hollard Ground floor plan	76
Figure 14. 6 Hollard Street. Street view and Aerial View.....	77
Figure 15. Average condition of Kopanong Precinct buildings in July 2015	80
Figure 16. Component-level Condition and Remaining Useful Life	81

3. List of Acronyms

ARCOM	The Association of Researchers in Construction Management
BIM	Building Information Modelling
CBD	Central Business District
CIDB	Construction Industry Development Board
CIM	City Information Modelling
COGTA	Department of Co-operative Governance and Traditional Affairs
CSI	Corporate Social Investment
CSIR	Council for Scientific and Industrial Research
DDG	Deputy Director-General
DBOT	Design Build Operate Transfer
DEAT	Department of Environmental Affairs and Tourism
DoE	Department of Energy
DPW	Department of Public Works
EBP	Existing Building Performance

EPC	Energy Performance Certificate
EPD	Environmental Product Declaration
ESCO	Energy Service Company
EU	European Union
EWWMP	Energy Water and Waste Management Plans
GBA	Gross Building Area
GBCA	The Green Building Council of Australia
GBCSA	The Green Building Council of South Africa
GDARD	Gauteng Department of Agriculture and Rural Development
GDCS	Gauteng Department of Community Safety
GDE	Gauteng Department of Education
GDED	Gauteng Department of Economic Development
GDF	Gauteng Department of Finance
GDHS	Gauteng Department of Human Settlement
GDID	Gauteng Department of Infrastructure Development
GDoH	Gauteng Department of Health
GDP	Gross Domestic Product
GDRT	Gauteng Department of Roads and Transport
GDSACR	Gauteng Department of Sports, Arts, Culture and Recreation
GDSD	Gauteng Department of Social Development
GFA	Gauteng Funding Agency
GIAMA	Government Immovable Asset Management Act
GLA	Gross Leasable Area
GPG	Gauteng Provincial Government
GPME	Gauteng Property Management Entity
GSSA	Green Star South Africa
HVAC	Heating, ventilation, and air conditioning
IDM	Integrated Demand Management
IFC	International Finance Corporation
IGBC	Indian Green Building Council
IPCC	Intergovernmental Panel on Climate Change
ISO	International Standards for Organization
IWBI	International WELL Building Institute
LCA	Life Cycle Assessment
MEC	Member of the Executive Council
NBR	National Building Regulations
NEES	National Energy Efficiency Strategy
OHS	Occupational Health and Safety
OoP	Office of Premier
OSHA	Occupational Safety and Health Administration
PPP	Public Private Partnership

RFP	Request for proposals
RFQ	Request for qualification
RICS	Royal Institution of Chartered Surveyors
RUL	Remaining Useful Life
SABS	South African Bureau of Standards
SANS	South African National Standard
SGCPSA	Saint-Gobain Construction Products South Africa
SGSSA	Saint-Gobain Sub-Saharan Africa
SLA	Service Level Agreement
SME	Small-to-medium enterprise
TUT	Tshwane University of Technology
UN	United Nations
UNEP-SBCI	United Nations Environment Program – Sustainable Buildings and Climate Initiative
UNFCCC	United Nations Framework Convention on Climate Change
UK	United Kingdom
UKZN	University of KwaZulu-Natal
WITS	University of the Witwatersrand
WPC	Water Performance Certificate

4. List of Definitions

Braamfontein	In the context of this study, Braamfontein refers to Braamfontein and surrounds.
Case study	“An empirical inquiry that investigates a contemporary phenomenon in depth and within its real life context especially when the boundaries between phenomenon and context are not clearly evident” (Yin, 2009).
Climate change	An ongoing trend of changes in the earth’s general weather conditions as a result of an average rise in the temperature of the earth’s surface often referred to as global warming (DEA, 2012).
Green buildings	Incorporates design, construction and operational practices that significantly reduce or eliminate the negative impact of development on the environment and people. Green buildings are energy efficient, resource efficient and environmentally responsible (GBCSA, 2016)
Sustainable refurbishment	Upgrading of the existing works by considering the facets of sustainability namely; social, environmental and economic facets.

Chapter 1: Introduction

1.1. Background

The purpose of the research is to identify the contextual barriers and opportunities pertaining to the sustainable refurbishment of existing public sector office buildings in the inner city area of Johannesburg, South Africa. In most cases, refurbishment is driven by cosmetic upgrade initiatives. The existing building stock possesses significant opportunity to improve building performance and reduce negative impacts on the environment. This study aims to highlight this potential of the existing building stock by addressing the barriers and presenting the opportunities pertaining to the sustainable refurbishment of existing public sector office buildings in the inner city area of Johannesburg, South Africa.

1.2. Context of the study

The Department of Energy (DoE) of the government of South Africa released the first National Energy Efficiency Strategy (NEES) in 2005. The NEES aimed to commit to energy efficient strategies by reducing the environmental impacts. Reduction targets were identified as per Table 1 below (DoE, 2016).

Table 1. Improvements in energy intensity (2000-2012) compared to the 2005 targets

Sector	2015 Target (based on 2000 baseline)	Performance to 2012
Economy-wide	12%	23,7%
Industry	15%	34,3%
Residential	10%	28,2%
Commercial & Public	15%	0,3% (electricity only, 2003-13)
Transport	9%	14,1% (reduction in sector-wide energy intensity)
Power Sector	15%	Probably achieved, although no baseline against which to measure percentage savings

Source: DoE, 2016.

The post 2015 NEES aims to improve on these achievements. The strategy has been framed to complement the strategies of the various other government departments (DoE, 2016). Table 1 indicates that the commercial and public sector have performed significantly poorly in comparison to the other sectors.

Although the commercial and public sector contribute to only 8% of the national energy usage, there is potential to translate into a significant saving in energy (DoE, 2012). Energy consumption within the public sector is expected to increase significantly in 2030 when compared to 2012 consumption levels. These increases can be mitigated by sustainable

interventions and refurbishments. The largest potential saving would be from the new stock of commercial buildings as well as the existing stock (DoE, 2016).

The energy consumption of the existing building stock will continue to exceed the energy consumption of new buildings till at least 2050. This date is based on scenarios used in South Africa that suggests overall reductions in energy use achieved from existing buildings would only amount to approximately 10% (Milford, 2009). Efficiencies of approximately 40% to 50% could be achieved in new buildings in the commercial sector and 30% to 40% in the residential sector (Milford, 2009). Therefore, it is important to focus on improving the energy performance of the existing building stock as well as that of new buildings (DoE, 2012).

The Intergovernmental Panel on Climate Change (IPCC, 2007) suggests that the building sector has the potential for delivering the greatest reductions in emissions at little or no costs. Based on this data the property industry may be well placed to deliver long term sustainable improvements, as well as influence and create behavioural change. Due to the huge negative environmental impacts caused by buildings, improving the performance of buildings appears to be an avenue that deserves attention. If no significant change is effected to the manner in which buildings are designed, constructed and maintained then greenhouse gas emissions are set to double in 20 years (UNEP-SBCI, 2009).

The existing building stock therefore presents a great potential and opportunity to reduce greenhouse gas emissions, reduce resource consumption, improve occupant comfort and wellbeing, reduce waste to landfill and deliver long term sustainable benefits. The purpose of the research is to identify the contextual barriers and opportunities pertaining to the sustainable refurbishment of existing public sector office buildings. This study aims to highlight this potential of the existing building stock by addressing the barriers and presenting the opportunities pertaining to the sustainable refurbishment of existing public sector office buildings.

1.3. Problem Statement

The current refurbishment of the existing building stock is not yielding improved sustainable building performance as in most cases, it is meant to be cosmetic upgrades/facelifts. This has led to a situation where the existing building stock is continuously lagging behind in terms of sustainable performance even after refurbishment. The contextual barriers and opportunities pertinent to the sustainable refurbishment of existing buildings in South Africa are here explored.

1.4. Research Question

What are the contextual barriers and opportunities pertinent to the sustainable refurbishment of existing public sector office buildings in South Africa?

1.4.1. Sub-questions

- 1.4.1.1. What is the status of the current building stock vis-a-vis the main tenets of green building performance in the public sector?
- 1.4.1.2. What are the relevant policies and frameworks associated with the sustainable refurbishment of existing buildings in South Africa?
- 1.4.1.3. What are the policy objectives of green building in South Africa?
- 1.4.1.4. What are the local implementation strategies?
- 1.4.1.5. What are the most efficient solutions and technologies to be implemented?

1.5. Aim

To identify the contextual barriers and opportunities pertinent to the sustainable refurbishment of existing public sector office buildings in the inner city area of Johannesburg, South Africa.

1.6. Research objectives

- 1.6.1. Analyse the current building stock vis-a-vis the main tenets of green building performance in the public sector.
- 1.6.2. Collate the relevant policies and frameworks associated with the sustainable refurbishment of existing buildings in South Africa.
- 1.6.3. Identify the policy objectives of green building in South Africa.
- 1.6.4. Analyse local implementation strategies.
- 1.6.5. Assess the success factors in the implementation of the different solutions and technologies.

1.7. Significance of the study

Through the literature review, the topic of sustainable development is introduced and defined. Green buildings and refurbishment of existing buildings is also defined and expounded upon. The potential that existing buildings present in terms of sustainable refurbishment is highlighted. The study is significant in that it presents this potential opportunity that the existing buildings hold and their multiple long term benefits which include but are not limited to; reducing greenhouse gas emissions, reduce resource consumption, improve occupant comfort and wellbeing, reduce waste to landfill, social development, employment opportunities and creating awareness and educating communities. The purpose of the research is to identify the contextual barriers and opportunities pertaining to the sustainable refurbishment of existing public sector office buildings. This study aims to highlight this potential of the existing building stock by

addressing the barriers and presenting the opportunities pertaining to the sustainable refurbishment of existing public sector office buildings.

1.8. Scope of the study

The scope of the research refers to the parameters that fall within the range of the study. It can be considered as the domain within which the solution to the problem in question will be found. The scope of the research defines what is contained within the range and what is excluded from the range of the study (Simon & Goes, 2013). Scoping assesses the situation guided by previously identified research focus. Understanding the specific context of an area of research also assists in examining the practicality of the research task. Scoping assists the researcher in planning what needs to be done, refining the objectives and understanding the resources required. It may also highlight important areas that require attention and the breadth and depth of the research. This could result in a more effective research process and result (Regoniel, 2013).

Scoping of the research and delimitations of the research are somewhat inter-related. The domain within which the solution to the problem statement will be found is that of the public sector. More specifically within the public sector, the study is contained within the range of existing office buildings and is contained within the inner city area of Johannesburg, South Africa. This area currently houses the GDID as well as numerous other government departments that either occupy their own buildings or lease other buildings. The Kopanong Precinct Project is also contained within this area and this is a key project to assess in this study. Further, this area is also selected for practical reasons including accessibility for the researcher. This scoping aids in planning as well as refining the objectives.

1.9. Delimitations and limitations of the study

Delimitations are those factors that are in the control of the researcher. These are intentional decisions taken by the researcher in order to ensure a degree of manageability of the study. Delimitations include setting the boundaries of the samples, sample location, type of responses accepted, measuring instruments to be used as well as time frames (Baron, 2012).

Delimitations in this study included dealing primarily with the existing building stock in the public sector. Within the public sector this study focused on office buildings only and not residential buildings. The reasons for this decision include those mentioned above related to ensuring a degree of manageability. Further, the public sector office building stock is most advanced in terms of legislating the sustainable refurbishment of the existing building stock through the promulgation of South African National Standards (SANS) 1544: Energy Performance Certificates for Buildings.

Limitations are usually those factors that are beyond the control of the researcher. These may affect the results of the study or the manner in which the results are analysed and presented. They are also useful for readers as they provide a manner to acknowledge errors or difficulties

in interpreting the data or results of the study. “Almost all areas of research will contain elements of limitations but only those that have a significant effect on the particular research problem in question should be included” (Baron, 2012).

A limitation of this research would be the lack of legislation regarding refurbishment of existing buildings at the time of this study. There exists a policy which will be reviewed in the study and this policy is currently in the process of being legislated. The lack of current legislation does not dilute the intention of this study as the aim of the study is to identify the contextual barriers and opportunities pertinent to the refurbishment of existing buildings in Johannesburg, South Africa.

Another limitation of the study would be the lack of available published case study examples in the public sector. There are a few that have been identified and have been referred to in the study. The majority of existing buildings that have been refurbished against a set of definitive criteria are those that aimed for Green Star South Africa certification and these are primarily in the private sector. Again, this limitation does not detract from the aim of the study. It does address both sub-question 1 and 3.

1.10. Structure of the Report

The report is structured by commencing with a concise abstract followed by an executive summary. Chapter one forms the introduction to the study and includes; the background, context, problem statement, research question, aim, research objectives, significance of the study, scope of the study, delimitations and limitations, structure of the report and the introduction summary.

Chapter two is the primary literature review and starts introducing and defining sustainable development. This is followed with a definition of sustainable or green buildings as well as definition of and contextualising of the refurbishment of existing buildings, first at global level and then at a local level. The existing buildings potential is highlighted in the midst of this chapter. Legislation and standards are expanded upon, the local green building council is introduced relative to this study and technology, well-being and occupant comfort is presented. Drivers and opportunities is followed by the gaps that have been identified through this literature review. A summary is presented based on this section of the literature review.

Chapters three and four are linked to and presented as a further development to the literature survey. Chapter three focusses on the status of the current building stock vis-a-vis the main tenets of green building performance in the public sector while chapter four discusses the policies and frameworks pertinent to sustainable development of the built environment for both new and existing buildings.

Chapter five is where the research methodology is expounded upon. This chapter includes an introduction as well as the case study approach and strategy. This is followed by research

philosophy and theoretical perspectives. Data collection, data analysis, identification of themes, sampling in research, validity and reliability as well as ethics in research is included in this chapter.

Chapter six commences by introducing the case study approach and method. This chapter includes all four case studies supporting this report as well as three additional semi-structured interviews which are not case specific but rather more general based on experience and expertise. A typical case study includes an introduction, project description, project scope, profile of the respondents, semi-structured interviews, addressing the research objectives and a summary.

Chapter seven is the cross case analysis. The analysis and findings as well as the analysis of the semi-structured interviews forms part of this chapter.

Chapter eight presents the conclusions and recommendations. The introduction is followed by the summary of the study and thereafter the conclusions and recommendations presented. Chapters nine and ten are bibliography and appendices.

1.11. Summary

This chapter is significant as it introduces the problem and explains the rationale for the study. The background and context of the study provides an introduction before the problem statement is presented. The research question and sub questions are key aspects which provides the necessary response to the problem statement. The aim and research objectives are linked to the research question and sub questions. The significance of the study provides the reasons why this study was undertaken. The parameters that fall within the range of the study is described as well as the limitations and delimitations of the study. The structure of the report is highlighted and provides an overview of the manner in which the report is organised.

Chapter 2: Literature Review

2.1. An introduction: the effects of construction works

Over their lifecycle, construction projects consume significant resources and contribute to the transformation of cityscapes, urban and rural landscapes. As a result, they have significant impacts on the environment, human health as well as economic consequences (ISO, 2008). *ISO 15392, Sustainability in building construction - General Principles* includes five reasons why the building and construction sector is of significance for sustainable development. One of these reasons is that the built environment has considerable opportunity to show improvement relative to its social, environmental and economic impacts (ISO, 2008).

The oil crisis of the 1970s highlighted to the western world the finite nature of natural resources and this resulted in the awareness of the concept of sustainable development. Sustainable development was meant as a continuous process that encompassed the critical and inter-related facets of environment, economy and society (Moschetti & Brattebø, 2016). Since the 1970s attention has been paid to improve the efficiency of energy use rather than just increase the supply to meet the growing demand. Energy consumption and demand is still growing globally. Efforts to address this may have been moderate or ineffective (Urge-Vorsatz, *et al.*, 2006).

2.2. Defining Sustainable Development

The oil crisis of the 1970s demonstrated that resources should be consumed sustainably to minimise the risk of shortages due to sudden scarcities. Sustainable development therefore began to emerge as a key consideration. "Among the many ways that sustainability has been defined, the simplest and most fundamental is: "the ability to sustain" or, alternatively, "the capacity to endure" (SustainAbility, 2010). Sustainable development has been described as meeting the needs and aspirations of people in a manner that does not compromise the ability of future generations to meet their own needs and aspirations (DPW, 2014). The primary facets of sustainability are interdependent: namely; environmental, social and economic facets (ISO, 2008). The Green Building Policy Draft 3 also refers to environmental sustainability, social sustainability and economic sustainability being the three components of sustainable development (Nordic Innovation, 2014; Department of Public Works, 2014).

The built environment construction and operations have significant direct and indirect effects on these three interdependent facets of sustainability. A sustainable approach to design, construction and operation is required to enable sustainability and contribute toward the ability of future generations to meet their own needs. The main objectives of sustainable design include reducing or completely avoiding the use of critical resources; water, energy and raw materials, to minimize the negative effects on the environment caused by buildings throughout their life cycle and to create comfortable and safe environments (Hesbacher,

2016). Sustainable buildings can be defined as those that fulfil the necessary performance requirements based on their intended use in an efficient and economical way with minimal negative effects on the environment (Nordic Innovation, 2014).

Climate change and other risks caused by rapid urbanisation are negatively affecting attempts at sustainable development (IFC, 2014). Rapid urbanisation in the world's most populous countries requires sustainable buildings to ensure sustainable development. Currently almost half of all the resources consumed globally are used in construction and 40% of the energy generated globally is used for building related functions (Aye, 2010). Buildings are responsible for 30% of worldwide greenhouse gas emissions and this figure will rise as populations continue to migrate to cities (Aye, 2010). The built environment consumes 40% of global material production and is responsible for 65% of municipal solid waste generation (Aye, 2010). The Intergovernmental Panel on Climate Change (IPCC, 2007) suggests that the building sector has the potential for delivering the greatest reductions in emissions at little or no costs. Based on this data the property industry may be well placed to deliver long term sustainable improvements, as well as influence and create behavioural change. Due to the huge negative environmental impacts caused by buildings, improving the performance of buildings appears to be an avenue that deserves attention. If no significant change is effected to the manner in which buildings are designed, constructed and maintained then greenhouse gas emissions are set to double in 20 years (UNEP-SBCI, 2009).

Morse (2008) shares a different view in his article titled "Post-Sustainable Development", where he presents sustainable development as being no more than another example of western hegemony. Either as an impact of imminent development or as a goal of intentional development, it is no more than business as usual that has been presented as inspirational and caring for the environment (Morse, 2008). Castro (2004) in his article titled "Sustainable Development" draws similarities between sustainable development with that of democracy and globalisation. He indicates that sustainable development has become one of the most omnipresent, challenged and essential concepts of our time (Castro, 2004).

Two events are cited as being the key events that ensured international awareness around the term sustainable development. These are the World Commission on Environment and Development in 1987 whose report is the Brundtland Report, and the Earth Summit in Rio de Janeiro in 1992 whose report is the Agenda 21. The definition of sustainable development in the Brundtland report has been criticised for being too vague, not defining what "needs" are and for not expanding on the mechanisms for achieving a sustainable society. Solutions presented in Agenda 21 have been criticised for not being realistic in practice. The example used is the idea that free trade promotes economic growth which results in poverty reduction which would result in reduced environmental degradation (Castro, 2004; Bell & Morse, 2008). Ten years after the Earth Summit in Rio de Janeiro, the World Summit on Sustainable Development took place in Johannesburg, South Africa in 2002 and global commitment to sustainable development was reiterated. The Johannesburg summit marked a further

expansion on the globally accepted and standard “Brundtland definition” of sustainable development by introducing the widely used three pillars of economic, social and environmental development. The Johannesburg declaration highlighted the inter-relationships and inter-dependencies of the three facets of sustainability (Kates, *et al.*, 2005).

Castro (2004) concludes by saying that sustainable development within the mainstream paradigm of development still prioritises economic growth through resource allocation and environmental concerns are incidental. According to Castro (2004), the main shortcoming of the mainstream approach to sustainable development is that the focus is on sustaining development rather than sustainable development where the environment and ecological concerns are a priority. Bell & Morse (2008) introduce their book “Sustainability Indicators. Measuring the Immeasurable?”, by questioning the motives behind sustainable development and its popularity. Contradicting positions are highlighted early on and these include quotes from Allen and Hoekstra (1992), “everyone agrees that sustainability is a good thing” to Fortune and Hughes (1997), “sustainability is an empty concept lacking firm substance” (Bell & Morse, 2008).

According to the National Environmental Management Act (Act No. 107 of 1998), “Sustainable development means the integration of social, economic and environmental factors into planning, implementation and decision-making so as to ensure that development serves present and future generations” (DEAT, 2008). Kates, *et al.* (2005), present an interesting view in their article in *Environment* titled, “What is Sustainable Development? Goals, Indicators, Values and Practices” when compared to that of Castro (2004), Morse (2008) and Bell & Morse (2008). Kates, *et al.* (2005) view is that defining sustainable development is challenging although the globally accepted understanding of the term sustainable development is associated with positive connotations. Since the Brundtland report many scholars and practitioners have adapted and promoted their own version of the definition of sustainable development, and a fixed and definite definition remains intangible. There is no single meaning of the term and no specific agreement on the manner in which it is measured (Kates, *et al.*, 2005; Bell & Morse, 2008). This has led to some practitioners referring to sustainable development as contradictory or other practitioners using adaptations of the definition to greenwash their activities (Kates, *et al.*, 2005). Sustainable development is a universal concept but its implementation is possible only in a defined spatial and political context and is limited by both space and time. It must be adapted to suit the local context (Avila-Pires, *et al.*, 2000). There is an ever increasing volume of evidence that there is measurable environmental deterioration and this is progressing into a state of great concern. However, there is little evidence suggesting that there is a shift in attitudes towards a more consistent and defined sustainable development process. A paradigm shift is necessary (Carvalho, 2001).

The National Treasury notes that the South African economy should also develop in a sustainable way. Issues of poverty and inequality are addressed, and quality of growth is

valued rather than just quantity of growth. The national vision for sustainable development should be shared by all South Africans. The Department of Environmental Affairs and Tourism confirms South Africa's aspirations to be a sustainable, economically prosperous and self-reliant nation. This is done through integrative planning and collaboration from local to global levels. Further, to safeguard our democracy through responsibly managing limited ecological resources for current and future generations (DEAT, 2008).

2.3. Sustainable or Green Buildings

According to The Green Building Council of South Africa (GBCSA), green building incorporates design, construction and operational practices that significantly reduce or eliminate the negative impact of development on the environment and people. Green buildings are energy efficient, resource efficient and environmentally responsible (GBCSA, 2016). The concepts of sustainable or green buildings, and constructions are broad. Generally, they can be viewed as design and construction processes that are resource efficient and environmentally responsible throughout the entire life cycle of the building. This would include the stages from construction through completion, operation, maintenance, refurbishment and demolition (DPW, 2014). Currently green buildings account for one quarter of the total share of construction activity globally amongst participants in a recent study (Jones & Laquidara-Carr, 2016).

South Africa is emerging as a leader in green building and is demonstrating a major commitment to building green. Results from the World Green Building Trends 2016 Report, indicate that South African survey respondents are working on green projects that account for 41% of their total work load. Further, by 2018, they expect over 60% of their work to be green projects. This degree of commitment to sustainable building practices could propel South Africa to global leadership status in the green building market in the next three years (Jones & Laquidara-Carr, 2016). The report by Milford (2009) concludes that the operation of residential and non-residential building sectors account for 23% of total emissions. The split between non-residential and urban and rural residential is 10% and 8% respectively. The manufacture of building materials accounts for the remaining 5% of emissions (Milford, 2009). The built environment presents an opportunity to address the effects it has on the environment. Focus should not only be directed toward new building design but also toward addressing the performance of the existing building stock in South Africa. Relative to new buildings currently, the existing building stock presents a significant opportunity to contribute toward a sustainable built environment through improved building performance.

2.4. Refurbishment of existing buildings: Global context

The significant opportunity for sustainable refurbishment presented by existing buildings could be realised through building refurbishment cycles and processes. The term "refurbish" is described as: to repair and make improvements to something such as a building and the term "renovate" is defined as: to make changes and repairs to an old house, building, room, etc. such that it is returned to good condition (Merriam-Webster, 2016). Maintenance refers

to the original standard being restored whilst the term improvement refers to the upgrading of the original standard.

Therefore maintenance carried out on an unsustainable building will return the building to its un-sustainable original condition (Adeyemi, *et al.*, 2014). The renovation of existing buildings includes reducing energy consumption and carbon dioxide (CO₂) emissions (Nielsen, *et al.*, 2016). Renovation of buildings generally refers to improving the performance of the existing building ranging from middle to major renovations. Sustainable renovation refers to a holistic consideration where social, environmental and economic aspects are encompassed in a balanced way. The refurbishment process is similar to the design of a new building which includes design, construction and operation of a building but refurbishment has the constraint of having an existing building and possibly existing users of that building (Nielsen, *et al.*, 2016). Applications of strategies to the refurbishment of existing buildings include; energy assessment and classification, identification of technological solutions for energy efficiency and the integration of renewal systems (Villa, *et al.*, 2013). Refurbishment could include a number of actions required to retain a building or improve it to an acceptable condition. The refurbishment process could also leave the building in a position where it performs significantly better than its original state (Hoffman & Dreyer, 2013; Bhuiyan, *et al.*, 2015). Refurbishment can be viewed as opportunities to not only improve the appearance and character of the building but to also enhance its technical performance. The need for refurbishment of existing buildings is a result of increased requirements for overall better quality of buildings. This is coupled with the common quest for energy efficiency in both residential and non-residential buildings (Nordic Innovation, 2014).

Improvement to existing buildings increases the life of those buildings as well as improves the living environment, increases property values, reduces urgency for redevelopment and enhances public safety and the image of the precinct and city (Adeyemi, *et al.*, 2014). There are several other terms that similarly define refurbishment such as; conversion, renovation, retrofitting, rehabilitation, restoration and adaptations. Sustainable refurbishment here refers to upgrading of the existing works by considering the facets of sustainability namely; social, environmental and economic (Masrom, *et al.*, 2017). The concept of sustainable development should address and integrate economic, social and environmental needs as much as possible (González, *et al.*, 2015). Existing buildings were constructed to the standards of the past, and standards and regulations have since improved regarding sustainable development. Generally, there is no need for existing buildings to be upgraded to meet the new standards which increases the performance gap between new buildings and the existing building stock (Adeyemi, *et al.*, 2014).

The European Union has placed a great emphasis on buildings as part of its strategy to achieve its climate targets for 2020. Forty percent of the energy consumption and one-third of carbon dioxide emissions in Europe are a result of the built environment. In order to effect change,

existing buildings need to be sustainably refurbished (Peyramale & Wetzel, 2017). Gluch & Svensson (2016) study titled, *"The organisational nexus of changing management practices for sustainable renovation"*, presented at the 32nd Annual Association of Researchers in Construction Management (ARCOM) Conference 2016 indicates that public construction client organisations must find new sustainable ways to renovate the existing building stock in order to address the ambitious government sustainability targets (Gluch & Svensson, 2016). Sustainable refurbishment faces many challenges including changing the historic manner of refurbishing buildings where aesthetics may have been higher priority to a more sustainable approach (Gluch & Svensson, 2016).

According to Adeyemi (2014), many of the countries in the developing world did not meet the United Nations (UN) sustainable development targets because they did not adequately address the issue of the performance of the existing building stock. Improvement of existing buildings is noted to be more environmentally friendly, more cost effective and will reduce operating costs when compared to building new (Adeyemi, *et al.*, 2014). Sustainable development must be addressed by improving the existing building stock. A focus on new buildings alone will yield minimal results for some time. The existing building stock form a great majority of the built environments therefore, more attention should be paid to them if a greater impact is expected (Adeyemi, *et al.*, 2014). In the built environment, most of the energy use and the greenhouse gas emissions are a result of the existing building stock. Across the world, policies, standards and methodologies are aimed at decreasing the use of energy in buildings (González, *et al.*, 2015; Moschetti & Brattebø, 2016). Refurbishing of existing buildings is globally accepted in the built environment as a significant issue. Globally the number of new buildings adds approximately 1% to the buildings stock. The remaining 99% represented buildings which exist and therefore require significant attention to improve energy efficiencies and reduce the negative impact on the environment. Studies have indicated that sustainable refurbishment which leads to extending the life of the building has a much lower negative impact on the environment when compared to demolitions and building new (González, *et al.*, 2015).

2.5. Refurbishment of existing buildings: The South African context

The total building stock in South Africa can be expected to double by 2050 based on historical trends and anticipated government investment programmes. If nothing is done to address CO₂ emissions this would result in a twofold increase (Milford, 2009). Energy efficiencies between 40 – 50% and 30 – 40% could be achieved in non-residential and residential buildings, respectively. A challenge noted is the ability to effect changes in existing buildings in South Africa and scenarios used indicate that existing buildings could still be responsible for 50% of the emissions in 2050 (Milford, 2009).

Jones & Laquidara-Carr (2016), results indicate that South Africa is one of the few countries where the highest percentage of the respondents expect to be doing green renovations in the

next three years. Forty six percent of respondents in South Africa expect to be completing green refurbishments and in this category the global average is 37% (Jones & Laquidara-Carr, 2016). Again this demonstrates South Africa's leadership attitude in the sustainable refurbishment arena.

2.6. The existing buildings potential

There are significant publications and research available addressing the opportunity that existing buildings offer and the challenges that are generally associated with the existing building stock locally. These include; *National Climate Change Response White Paper, Sustaining Existing Buildings, People-Planet-Prosperity, A National Framework for Sustainable Development in South Africa, Post-2015 National Energy Efficiency Strategy, Towards a Green Building Policy Framework: First Draft, Department of Public Works, Green Building Policy Draft 3* and *Gauteng Department of Infrastructure Development Strategic Plan* are some of these publications and research. Several countries worldwide consider sustainable refurbishment to be an effective approach to reducing the carbon dioxide emissions from existing buildings (Moschetti & Brattebø, 2016; Masrom, *et al.*, 2017). These studies have also concluded that deep refurbishment is the optimum approach from both an environmental and economic perspective. Cosmetic upgrades only increase the risk of not meeting climate and sustainability targets. This also results in not taking advantage of the potential total savings (González, *et al.*, 2015). Energy retrofits offer multiple benefits for society, developers and occupants. These include, reducing greenhouse gas emissions, reducing utility bills and maintenance costs, creating new job opportunities and improving the well-being of the occupants and communities (Moschetti & Brattebø, 2016). These actions produce powerful new opportunities for all stakeholders including energy service companies, financing institutions and building owners (Moschetti & Brattebø, 2016). The built environment presents significant opportunity for energetic optimisation that needs to be realised. This should not just be applied to a select few projects but implemented on a large scale. Economic efficiencies have also proved to be a decisive driver. Building owners are more prone to deep refurbishment on a large scale if it results in economic savings as well (Peyramale & Wetzel, 2017).

South Africa's existing building stock is largely inefficient (DPW, 2014) and a study by United Nations Environment Program – Sustainable Buildings and Climate Initiative (UNEP-SBCI) indicates that even considering likely scenarios of energy efficiency measures, the annual greenhouse gas emissions from existing buildings will still exceed that of new buildings in 2050 (UNEP-SBCI, 2009). In the United Kingdom (UK), new buildings account for 1% when compared to the existing building stock (Haase, 2011). At this rate it may take some time before new buildings will form a significant portion of the building stock (Haase, 2011). Therefore, sustainable refurbishment offers the best opportunity to improve the performance of the built environment. There is potential for an existing building's performance to be improved considerably more than its original state. There is pending

legislation, SANS 1544 Energy Performance Certificates for buildings – Draft 1, that will support improving the performance of the existing building stock in South Africa.

Other studies concerned with the sustainable refurbishment of existing buildings or energy efficient retrofitting of existing buildings have focused on different aspects like costs associated and perceptions of the stakeholders (Hoffman & Dreyer, 2013). Other mechanisms for energy efficient retrofitting include re-commissioning the buildings' major service equipment, building technology improvement and energy performance contracting or auditing (Wafula & Talukhaba, 2010). A similarity and the main driver behind the studies is the significant carbon footprint and poor technical performance of the current existing building stock and the need to incorporate the existing building stock into future built environment sustainable development strategies (Hoffman & Dreyer, 2013). Buildings and the built environment are both a significant part of the problem and solution addressing the effects of climate change and our impact on the environment. Improving the energy efficiency of buildings has multiple effects including reducing greenhouse gas emission as well as reducing the utility bills (Wafula & Talukhaba, 2010). Well considered and cost effective measures implemented at refurbishments of existing buildings can yield significant energy savings (Wafula & Talukhaba, 2010). A refurbished building has the potential to be as functionally efficient and environmentally sustainable as a new building (Babangida, *et al.*, 2012). Opportunities for refurbishing buildings include; the need to rearrange space to suit new users, increase the value of the property, improve quality, replace degraded finishes, increase rental income, improve aesthetics, make buildings more energy efficient or replace the building envelope (Babangida, *et al.*, 2012).

A study focussing on an exploration of the barriers to sustainable refurbishment in Malaysia found that key barriers were perceived higher costs of sustainable refurbishment when compared to traditional methods, lack of government initiative, expertise, as well as a lack of awareness pertaining to sustainability amongst Malaysians (Masrom, *et al.*, 2017). In the Malaysian context, there were instances where sustainable refurbishment prevailed over the cost concerns. These were market or tenant demand and company corporate social responsibility programs. Respondents noted that there were longer payback periods and increasing the rent could result in losing the existing tenants (Masrom, *et al.*, 2017). The government is still lacking in encouraging sustainable refurbishment - government should lead by example. Expertise in sustainable refurbishment, knowledge related to sustainable refurbishment and sustainability awareness are all interlinked barriers to sustainable refurbishment of existing buildings. The professionals and consultants are building their knowledge and expertise in sustainable refurbishment in order to guide the decision making process. Negative perceptions and changing mind-sets could be enabled through knowledge sharing and upskilling of all stakeholders in the project. This will support a greater awareness of sustainable refurbishment of existing buildings (Masrom, *et al.*, 2017).

Adeyemi, *et al.* (2014) also noted factors affecting improvement implementation which converged around financial concerns. These included; the buildings structure and capacity to accommodate new requirements, energy efficiency of the building envelope, potential to meet new health and safety and accessibility requirements, condition of mechanical systems and capacity for modification, presence of hazardous materials, ability of the building site to provide a safe and secure environment as well as convenience around the building location (Adeyemi, *et al.*, 2014).

South African challenges noted in the literature review titled, *“Energy efficient retrofitting of existing buildings: Costs and Stakeholder misconceptions”* included; the lack of records and information required to analyse the existing buildings’ energy usage, owners being unaware of their buildings inefficiencies, stakeholders being unaware of which energy efficient measures will provide them with the most attractive return on their investment, misalignment of the desire to effect change between the investor, developer, owner, installer and user or occupant (Hoffman & Dreyer, 2013). Another challenge noted is the focus of legislation primarily on new buildings and not the existing building stock (Wafula & Talukhaba, 2010). One of the conclusions of the deliberations of the Royal Institution of Chartered Surveyors (RICS) conference held in Brussels in 2008 included the emissions reduction potential that could be obtained through sustainable refurbishment of the existing building stock. A study in Malaysia also found that focus only on new buildings and not existing buildings resulted in a missed opportunity for sustainable refurbishment of existing buildings. The study noted that only nine refurbishments were certified although there are approximately 1000 refurbishments per year over the three year period (Masrom, *et al.*, 2017). Barriers of sustainable refurbishment included; financial, technical, social and lack of regulations regarding sustainable development (Masrom, *et al.*, 2017).

2.7. Legislation & Standards

South Africa’s National Building Regulations and Building Standards Act (Act no. 103 of 1977) does not specifically address sustainably refurbishing existing buildings. Legislation is required and would drive the change required in the built environment where existing buildings are concerned. Revising the building regulations to address the energy efficient refurbishment of the existing building stock is the most effective and direct manner of achieving a more sustainable built environment. Government incentives would support and address the voluntary deep energy efficient refurbishment required (Wafula & Talukhaba, 2010). The success of the legislation is dependent on compliance of the construction industry and this result in more efforts towards training and awareness and the role of local authorities and building inspectors (Wafula & Talukhaba, 2010).

The pending energy performance certification regulation will require all South African government owned and leased buildings to disclose and prominently display the buildings energy performance through an energy performance certificate (Hayes, *et al.*, 2016). South African National Standards (SANS) 1544:2015 Energy Performance Certificates for buildings,

will address refurbishment of public sector buildings as mandatory. This will eventually filter through to the private sector. It is envisaged that change of ownership may be a mechanism that supports the use of SANS 1544 in the private sector (DPW, 2014). This is supported by the Construction Industry Development Board's (CIDB), Dr Rodney Milford who said, "The idea is that the Energy Performance Certificates (EPC) will have to be displayed on state owned buildings with the intention that the regulation be extended to cover the commercial sector by around 2020" (Hayes, *et al.*, 2016). Once the performance of the existing building is measured and verified, appropriate interventions can be considered and implemented to improve the performance. Lisa Reynolds who was the Sustainability Director at Saint-Gobain Construction Products South Africa said in an Earthworks journal article, "understanding your buildings performance is the first step in the energy efficiency journey. The later drive to retrofit the building into a more energy efficient one is the ultimate goal. As with all things, if you can't measure it you can't manage it" (Hayes, *et al.*, 2016).

The South African Bureau of Standards (SABS) Standards Division develops and issues national standards, where the term "standard" is used generically to refer to a specification, code of practice or standard method. The 10400 suite of documents covers provisions for building site operations, building design and construction that are deemed to satisfy the provisions of the National Building Regulations (SABS Standards Division, 2009). South African National Standard (SANS) 10400-XA: Energy usage in buildings is a minimum standard for new buildings as well as refurbishments where submission of building plans to the local authority is required. SANS 204: Energy efficiency, is a voluntary standard that is also a minimum requirement for consideration for Green Star South Africa (GSSA) certification. Legislation and regulation is the key driver for transformation of the development of the built environment. The Department of Public Works (DPW) *Green Building Policy* sets out the policy for applying sustainable development principles and technologies to its own building portfolio. The DPW will provide leadership in the procurement and operation of green buildings within South Africa with the organs of state. This will occur through the DPW Green Building Policy. As described above, the adoption and implementation of EPC, SANS 10400: XA and SANS 204 will be reinforced by the DPW. This will be supplemented by eco-labelling programs, Green Building Rating, Water Performance Certificates (WPC) and Energy, Water and Waste Management Plans (EWWMP) (DPW, 2014). The DPW, through the implementation of the Green Building Policy aims to support sustainable development in South Africa, job creation and the development of green jobs and roles, improved working and living conditions, the development of cost effective solutions and the efficient use of resources through the lifetime of the building (DPW, 2014).

2.8. The Green Building Council of South Africa

The Green Building Council of South Africa has developed the Existing Building Performance Tool which is designed to cater for the existing building segment. Projects are measured, rated and rewarded for their promotion and implementation of green building practices, programs and technologies. This tool makes it possible for owners of existing buildings to receive the

Green Star South Africa rating. This supports the Green Building Council of South Africa's objective of promoting sustainable development and facilitating the transition of the South African property industry toward a more sustainable approach to developing the built environment (GBCSA, 2016). According to the 50 Certification Publication, new buildings in South Africa amount to 2% of the building stock while the remaining 98% are existing buildings (GBCSA, 2014). Currently, there are 34 projects registered for Existing Building Performance rating on the GBCSA website (GBCSA, 2016). In addition to sustainable design concepts for new buildings, sustainable refurbishment of existing buildings is preferred and recommended when compared to building new facilities. Sustainably refurbishing existing buildings can be more cost effective than building a new facility. Further one could expect a decrease in operation costs and environmental impacts as well as increased building resiliency (Babangida, *et al.*, 2012; GBCSA, 2016).

2.9. Technology, well-being, occupant comfort

The business case is not very compelling if the primary discussion regarding the refurbishment of existing buildings is energy cost savings alone (Newman, 2012a). Green building is also being driven by a sense that these buildings will improve and enhance productivity. This is being viewed as more valuable than the savings gained from decreased utility bills (Newman, 2012a; Newman, 2012b). Occupant comfort, well-being and productivity are becoming key considerations in the design and construction of buildings.

New technologies and methodologies in design and construction are yielding greater efficiencies and support sustainable habitat. There is a growing trend regarding occupant comfort and increased productivity and user satisfaction. Kaderják, *et al.*, (2012), states that investment in building refurbishment brings additional benefits including health and social effects. Sustainable refurbishment approaches have multiple benefits including increased marketability, staff retention, decreased churn and less volume to landfill therefore, more profitable assets and facilities. Indoor environment quality and acoustic comfort is receiving greater attention than previously and this is apparent in current Green Star South Africa rating tools (GBCSA, 2016). The International Well Building Institute has published the first standard of its kind that focuses solely on the health and well-being of its occupants. Buildings should not only be better for the planet but also better for the people. Human health and comfort should be elevated to the forefront of building practices (International Well Building Institute, 2016).

The current rapid advances in technology are changing the manner in which manufacturers convey product and system data to their customers. Over the last twenty years, advances in information technology have revolutionised design and production processes. Manufactured goods can now benefit from the analysis of any component and iteration in addition to performance criteria per assembly type. Architects and engineers are now applying this to buildings and the built environment through building information modelling solutions (Autodesk, 2008). These solutions are able to provide continuous and immediate feedback

over a range of characteristics. These range from, thermal performance, light quality, acoustic comfort, site disturbance, energy performance, in addition to “what-if” analysis between new constructions and refurbishments (Autodesk, 2008). Architects and designers are required to be even more informed on solution specification and their performance. This enables the virtual building to provide increased amounts of significant decision making data that informs and enables optimum building performance. The virtual model lifespan extends beyond design and construction well into building operation and maintenance. This methodology can be applied to existing buildings as well.

2.10. Drivers & Opportunities

Drivers that encourage sustainable refurbishment implementation included; reduction in operating costs, reinforcing the company’s image and reputation through sustainable development practices, regulatory requirements and reduction of the environmental impact as a result of development (Masrom, *et al.*, 2017). The biggest drivers were increasing marketability of the business and reducing environmental impact. In Malaysia, regulatory requirement was not a sufficient driver as the industry was not ready for this type of regulation. Seventy five percent of respondents agree that reduction in operating costs is a good driver for sustainable refurbishment of existing buildings (Masrom, *et al.*, 2017). When buildings are sustainably improved, it is expected that their maintenance costs will be considerably reduced. There is a growing perception that the cost of sustainably refurbishing an existing building is far cheaper than demolishing existing and developing a new building (Adeyemi, *et al.*, 2014). Energy scoring methods are available that lead to a prioritisation of properties and the determination of expected investments. A process designed to ensure that buildings can be objectively assessed and aligned. This approach allows for the most effective measures identified per building which lead to the greatest potential economic savings (Peyramale & Wetzel, 2017).

Demolition is regarded as an environmentally unfriendly process. Studies show that improving an existing building generates less waste, uses less material and energy when compared to demolition and new build. There are significant benefits across the three facets of sustainability of improving an existing building sustainably in comparison to demolition. Included benefits are; reduced waste to landfills, reuse of materials, reduced transportation and transportation costs, maintaining community infrastructure and developing local skills (Adeyemi, *et al.*, 2014).

2.11. Gaps and challenges identified

A gap noted in the literature is that the focus is primarily energy efficiency and no significant attention to waste and water management. The identification of the contextual barriers and opportunities pertinent to sustainable refurbishment of existing buildings should include all aspects of sustainability pertaining to people, planet and prosperity. This should be addressed through a “circular economies” approach. A gap identified by Wafula & Talukhaba (2010) was the lack of cost estimation data for energy efficient retrofits when compared to traditional

cosmetic upgrades. Financial experts do not view energy efficient upgrades as investments but rather as measured expenses, much like consumables.

A study by Sara Wilkinson, "*Analyzing trends in sustainable building adaptations in Melbourne CBD*", presented at RICS/COBRA conference 2016, aimed to analyse the office building refurbishments and identify the important building attributes. This study also highlighted the multi-faceted decision making process at refurbishment projects. These included; building physical attributes, age of the building, frame condition, floor size, regulatory compliance, service core location, the ability to sub-divide, access to site, technical grid, floor strength, services equipment, ability for extra capacity, modularity and elasticity (Wilkinson, 2016). In addition, physical location, proximity to public transport, site parking and land use requirements or limitations were important considerations for refurbishment projects. Also potentially viewed as a gap is that refurbishments have to be financially viable and increased occupancy rates are positive indicators of viability. In most instances, it is possible to improve the quality, performance, rental and capital values of buildings through sustainable refurbishment (Wilkinson, 2016). The importance of water economy was also highlighted in this study by noting that most existing building stock was built with little attention to minimising water use, and refurbishment presents an opportunity to reduce, recycle, harvest and re-use water.

Through a method of analysing a database of 589 projects the study identified the major five typologies that accounted for the majority of refurbishments contained in the 2013 survey data. These typologies are; tall corporate owned buildings with good energy ratings, large buildings, newer top grade office buildings, buildings in Melbourne not in North Melbourne, East Melbourne heritage grade buildings. Owners not engaged in refurbishment included privately owned, smaller buildings, lower grade and without any heritage value (Wilkinson, 2016).

Another gap identified is the need to incorporate the existing building stock into future built environment sustainable development strategies (Hoffman & Dreyer, 2013). Buildings need to be able to adapt and to rearrange space to suit new users, increase the value of the property, improve quality, replace degraded finishes, increase rental income, improve aesthetics, make buildings more energy efficient or replace the building envelope (Babangida, et al., 2012). The perceived higher costs of sustainable refurbishment when compared to traditional methods, lack of government initiative, expertise, as well as a lack of awareness pertaining to sustainability amongst Malaysians is another gap that has been identified (Masrom, et al., 2017).

A lack of awareness and a shortage of skills has been identified. Expertise in sustainable refurbishment, knowledge related to sustainable refurbishment and sustainability awareness are all interlinked barriers to sustainable refurbishment of existing buildings. This will support a greater awareness of sustainable refurbishment of existing buildings (Masrom, et al., 2017).

Further challenges include the existing buildings potential to improve the energy efficiency of the building envelope, potential to meet new health and safety and accessibility requirements, condition of mechanical systems, as well as convenience around the building location (Adeyemi, et al., 2014). Often owners are unaware of their buildings inefficiencies and relevant stakeholders are unaware of which energy efficient measures will provide them with the most attractive return on their investment (Hoffman & Dreyer, 2013). This is another gap that is explored through the structured interviews. The focus is largely still on new buildings when sustainable measures are concerned and a study in Malaysia noted that only nine refurbishments were certified although there are approximately 1000 refurbishments per year over the three year period (Masrom, *et al.*, 2017)

Other studies concerned with the sustainable refurbishment of existing buildings or energy efficient retrofitting of existing buildings have focused on different aspects like costs associated and perceptions of the stakeholders (Hoffman & Dreyer, 2013). Other mechanisms for energy efficient retrofitting include re-commissioning the buildings' major service equipment, building technology improvement and energy performance contracting or auditing (Wafula & Talukhaba, 2010). A similarity and the main driver behind the studies is the significant carbon footprint and poor technical performance of the current existing building stock and the need to incorporate the existing building stock into future built environment sustainable development strategies (Hoffman & Dreyer, 2013).

2.12. Summary

Recommendations included increasing the awareness of relevant stakeholders on the options available to facilitate the sustainable refurbishment of existing buildings. These could include education and outreach programmes. Established facts regarding implemented solutions and comprehensive case study examples would be welcome mechanisms to encourage potential decision makers to implement these interventions. Currently, South African legislation only focuses on new buildings. This efforts and development must now progress to addressing the existing buildings stock as well. Government incentives, frameworks and policies and their implementation should be analysed further. Some landlords have discovered the benefits of improved efficiencies and tenants are showing signs of demanding better building performance (Wafula & Talukhaba, 2010; Hoffman & Dreyer, 2013).

The stakeholders involved in the design, construction and financing of the building are often different from those facilitating management of the on-going operation and maintenance of the building. The initial role players do play a significant part in the process as their decisions considerably impact the future performance of those particular buildings. The benefits of sustainable refurbishment will contribute to the preservation of the existing built environment (Newman, 2012a).

Based on the literature reviewed thus far, the promotion of sustainable building practices and technologies especially related to existing buildings is apparent. Opportunities and the potential for improving energy efficiency in buildings continue to be significant in countries

worldwide. More robust policies and frameworks supported by agile monitoring and compliance mechanisms are required to meet this potential (Urge-Vorsatz, *et al.*, 2006). Further investigation is required where specific solutions including product and configurations are concerned. This may be guided by product manufacturing processes and guidelines or best practices. This may also lead to third party product certification for relevant eco-labelling or green labelling and certification. The first draft V2 of *Toward a Green Building Policy Framework* describes Life Cycle Assessments (LCAs) as a tool which could be used to improve the environmental performance of construction products. However, they should not be considered in isolation because some products with an initial high environmental load could significantly off-set that load over the life span of the product and buildings (DPW, 2011). Products may deliver equivalent energy efficiency performances during use stage but may have significantly different impacts on the environment during extraction and manufacture stages.

These old buildings are generally heavier constructions and the common practice is to address the building envelope to improve the thermal performance (González, *et al.*, 2015). The largest savings in gross electricity demand can be achieved through measures such as; implementing energy efficient lighting, insulation and more efficient Heating, ventilation, and air conditioning (HVAC) systems (Wafula & Talukhaba, 2010).

Sustainable refurbishment is becoming more feasible as energy and operational costs continue to rise, and advanced and efficient technologies and building products become more financially feasible (Milne, 2012). Existing buildings can be steadily greened by moving to more efficient options as part of a normal maintenance programme or end-of-life replacement. It can be easier to justify an investment when it is included in an annual maintenance or capital expenditure budget, rather than attempting a large scale retrofit or upgrade. Green building is often about doing things differently, rather than necessarily spending more (Milne, 2012). The most effective and efficient solutions or combination of solutions are to be identified and communicated. The conditions related to the existing building concerned would most likely be the driver of the solutions to be implemented. It is unlikely that would be a specific set of principles that would be applicable to all existing buildings or existing building types.

A greater understanding contained within a single body of information highlighting the South African opportunity within the existing building segment would be valuable. This would offer an opportunity to tailor solutions and strategies as required.

The purpose of the report titled, *“State of the Stock – What do we know about existing buildings and their future prospects?”* was to provide a brief outline of the state of knowledge of the existing building stock and the future potential advances of that knowledge. Although primarily focused on the residential market interesting data and trends were identified that could be linked to the commercial market. The user’s interaction and experiences in their

dwellings drove future retrofitting projects. Energy efficiency, thermal comfort and changing climatic conditions were linked to security concerns and productivity. Components of change were also driven by changing family structures, financial constraints and opportunities. In this study, the single greatest potential for advancement was the optimum use of information technology (Ravetz, 2008). This included visual maps, visualisations and virtual reality versions of buildings. THINK, which is financially supported by the European Union (EU) released a report in June 2012 titled, “*How to refurbish all buildings by 2050*”. This report identified three primary challenges affecting the refurbishing of existing buildings; distorted energy prices, unqualified decision makers and simple market failures. Recommendations from the study included; establishing a national building refurbishing target, creation of energy performance certificates, facilitating the design of a market building refurbishing process, developing a refurbishment development roadmap and funding to support selected implementation (Kaderják, *et al.*, 2012). Much of these strategies are being planned and implemented locally and much could be learned and customised to suit the local context upon further analysis.

Another key factor for consideration is a high level comparative analysis between the performance and sustainable attributes associated with the implementation of a new building versus that of a sustainably refurbished existing building. *Sustainable Perspective of an Existing Building* by the Indian Green Building Council (IGBC) Rating System supports the sustainable refurbishment of existing buildings, as the construction of new buildings could require more energy and water, and generate more waste after construction which will be primarily directed to landfill (More, *et al.*, 2014).

The challenge that industry is faced with regarding the energy and building performance of the existing building stock is global and not limited to the South African context. This area of research has attracted significant attention and although typically the research is customised to local context, there are lessons to be gained which could be adapted to suit the South African context. An exploration of suitable case study examples related to both building and city performance would be valuable to this study to further reinforce assumptions and outcomes.

Chapter 3: Status of the current building stock vis-a-vis the main tenets of green building performance in the public sector: literature survey

3.1. Context

Public sector buildings are classified within the commercial sector and form the largest part of the total building stock in South Africa. The total building stock in South Africa is estimated at approximately 50.2 million square meters. The estimated value is between R250 and R500 billion (DPW, 2016).

Table 2. Total public sector building stock

Million m ²	2012	2015	2020	2025	2030
Offices	23,17	27,25	36,00	48,82	63,35
Educational Facilities	11,48	11,74	13,28	15,01	16,97
Healthcare Facilities	5,75	5,77	6,53	7,38	8,34
Other	6,69	7,61	7,71	8,72	9,86
Total	47,09	52,37	63,99	79,93	100,52

Souce: DPW, 2016.

The GDID vision is to be the leading infrastructure provider and to position Gauteng as a globally competitive city region with a sustainable and growing economy (GDID, 2015).

“The Gauteng Department of Infrastructure Development’s mission is to contribute towards the radical transformation, modernisation and re-industrialisation of Gauteng by accelerating integrated service delivery, maintenance and management of public infrastructure and deploying built environment professionals while encouraging the active participation of an empowered citizenry” (GDID, 2015).

The administration has adopted a ten pillar program supported by key strategic implementation goals over the next five years. The department has also identified eight interventions as game changers which will assist the department achieve its service delivery goals (GDID, 2015).

The GDID has an immovable asset portfolio that consists of a total of 5131 assets under the custodianship of the GDID. These assets are distributed across the five development corridors. Most of the assets are located in the central corridor.

3.2. The Green Agenda

Growing a green economy has been identified as a means to achieve the vision of the GDID. The strategy to grow the green economy is called The Green Agenda which comprises three programs that are expected to make the biggest impact in the province; rooftop solar panel rollout, resource efficiency retrofit (energy and water) and natural gas program. The main consequences of the effects of the built environment on the planet as related to the GDID

portfolio are; inefficient energy consumption, waste generation, inefficient water usage, surface runoff relating to hard surfaces, inefficient land use and poor indoor and outdoor work environments (GDID, 2015). These consequences have negative effects on human health, greenhouse gas emissions, pressure on landfills, energy security, air and water quality, lack of connectivity and occupant well-being as well as worker health and safety.

The focus of the Green Agenda initiatives has been renewables, alternative energy programs as well as initiatives aimed at gaining efficiencies in energy, water, waste consumption and generation. The core objective is to promote the green agenda which will enable job creation, sustainability and economic development. This should position Gauteng at the forefront of the green agenda. The aim of the green agenda includes the following; job creation, skills development and sustainable economic growth (Chimusoro, 2015).

The rooftop solar panel rollout, resource efficiency retrofit (energy and water) and natural gas programme, Waste to Gas (energy) programme, panels on mine dumps and other green technologies are opportunities that have been identified by the GDID that respond to the challenges faced by Gauteng and South Africa. The challenges include the inefficient use of energy and water, accelerated climate change, increased demand for energy and rising energy process and limited fresh water resources. Implementation of the green agenda has the potential to reduce our carbon footprint and boost job creation. An increase in skills development as well as increase in the provincial Gross Domestic Product (GDP) are also some of the expected benefits (GDID, 2015).

3.2.1. Rooftop Solar PV Rollout Programme

Due to Gauteng's excellent solar irradiation levels, the use of solar technologies is well placed. Gauteng's government buildings provide approximates eight million square meters of rooftop potential for solar panel placement. The technology would be solar photovoltaic technology. This scale of implementation has the potential to ignite local production and associated services including job creation, skill developments and economic development (Chimusoro, 2015).

3.2.2. The Resource Efficiency Retrofit Program

Eskom's Integrated Demand Management (IDM) program aims to reduce energy consumption by the public, industry and government. Gauteng government has a large portfolio of existing buildings that have great potential to be more resource efficient. These buildings and facilities can be refurbished using green technologies in support of the green agenda. Numerous buildings were earmarked for the refurbishment project and are included but not limited to these below:

- Department of Health (35 hospitals, 287 clinics & 24 community health centres)
 - Department of Social Development (59 facilities)
 - Department of Community Safety (26 facilities)
 - Department of Transport (39 facilities)
 - Department of Agriculture, Conservation & Environmental Institutions (7 nature reserves)
- (Chimusoro, 2015).

This large scale refurbishment project aimed to stimulate the local economy. Future phases for refurbishment at government and municipality buildings were planned.

Eskom and GDID will conduct audits to establish the baseline from which the interventions will be identified. The resource efficient technologies for water and energy will be applied and the monitoring will take place to highlight improvement in performance and demonstrate savings in utilities. Key stakeholders will include; GDID, experts, consultants, energy service companies (ESCOs), technology partners and building owners (Chimusoro, 2015).

3.2.3. Other potential opportunities

The three flagship programs described above; rooftop solar, the retrofit program and natural gas program are the core programs aimed at the green agenda objective. Other opportunities that contribute to the reduced carbon footprint will also be considered and these include; water efficiency, waste reduction and microgeneration initiatives (Chimusoro, 2015).

Water conservation strategies include rainwater harvesting, water efficient technologies, leak detection, water recycling and greywater systems. Water reduction strategies include that of reducing, reusing and recycling. Microgeneration is the production of energy on a small scale. An example of this would be mini wind turbines (Chimusoro, 2015).

3.3. Summary

The GDID has a clear and encouraging vision. The departments mission, ten pillar program and game changer interventions are intentional and will support the departments vision. Growing a green economy has been identified as a means to achieve the vision of the GDID. The strategy to grow the green economy is called The Green Agenda. The Green Agenda comprises three programs that are expected to make the biggest impact in the province; rooftop solar panel rollout, resource efficiency retrofit (energy and water) and natural gas program. Promoting the green agenda enables job creation, sustainability and economic development and this will position Gauteng at the forefront of the green agenda. Activating and promoting the green agenda will facilitate; job creation, skills development and sustainable economic growth.

Chapter 4: Policies and frameworks pertinent to sustainable development of the built environment for both new and existing buildings: literature survey

4.1. Introduction

The respondents referred and directed to the various framework and policies listed below. Generally, the built environment professionals appreciate the significant opportunity that existing buildings present at the time of refurbishment to improve its performance across multiple criteria including the facets of social, environmental and economic development. South Africa has a relatively well developed climate change and energy efficiency policy framework in place.

Respondent 5.1.1: Instrumental in the development of SANS 10400 XA and SANS 204. Previous sustainability director at a multinational leading company. Current director at a sustainability consulting and advocacy organisation.

Respondent 5.1.2: Founder and partner of a leading South African green building consultancy. She has significant experience in sustainability and the built environment. She holds two Masters degrees focusing on sustainability and worked at Council for Scientific and Industrial Research (CSIR) and lectured at University of the Witwatersrand (WITS).

Respondent 5.1.3: He is currently the program manager for construction industry performance at the Construction Industry Development Board. He was previously a director at CSIR Knowledge Services and Building and Construction Technology.

Respondent 5.1.4: He is a principal researcher at the CSIR currently, focusing on sustainable building and construction methods. He is a researcher, guest lecturer and designer with extensive experience and has won numerous awards and accolades over the years.

Policies and frameworks:

- DPW green building policy
- Post-2015 National Energy Efficiency Strategy – first draft March 2016
- Green Building Norms & Standards WP3: Existing Buildings - Draft 2
- SANS 1544 Energy Performance Certificates for buildings – Draft 1
- SANS 10400 XA
- SANS 204
- Green Building Norms & Standards WP3: Existing Buildings - Draft 2
- Maintenance Management Standard. National Immovable Asset Maintenance Management
- Maintenance Monitoring and Evaluation Protocol
- National Climate Change Response White Paper

4.2. DPW Green Building Policy

The Department of Public Works' Green Building Policy sets out principles by which the department will develop, maintain and operate their buildings. The department will ensure that state buildings reduce their environmental impact, are energy efficient, resource efficient and environmentally responsible (DPW, 2016).

The primary aim of the policy is to articulate DPW's vision for sustainable building and construction. The overall objective of the policy is to ensure that activity in the construction and property industry actively support sustainable development. This includes; supporting the green economy, improving the performance of the assets by reducing energy and water consumption, application of green procurement, enhancing social well-being and creating green jobs and facilitating the reuse of building material at the end of life stage (DPW, 2016).

The Department of Public Works' Green Building Policy applies to all buildings that are owned, operated and leased by the department. The Department of Public Works' Green Building Policy is aligned to the following, some of which are summarised later in the report;

- i) the National Water Act (1998);
- ii) the National Climate Change Response White Paper (2001);
- iii) the National Energy Efficiency Strategy (2005, 2012);
- iv) the South African Long Term Mitigation Scenarios (LTMS) (2007);
- v) the Government Immovable Asset Management Act (GIAMA) (2007)
- vi) the National Framework for Sustainable Development in South Africa (2008);
- vii) the DPW National Framework for Green Building (2011);
- viii) the National Water Resource Strategy (2013); and
- ix) the National Immovable Asset Maintenance Management (NIAMM) Framework (2015).

(DPW, 2016)

The implementation of this policy will result in the Department of Public Works supporting; sustainable development in South Africa, job creation and the realisation of green jobs, supporting improved living and working conditions and the efficient use of resources during design, construction and operation of buildings (DPW, 2014).

The primary purpose of this policy is to articulate the departments vision for sustainable development and construction, and to present key interventions that will reconfigure the manner in which the construction and property industry operates (DPW, 2016). The overall objective of the policy is to ensure that the activities of the built environment support sustainable development and improve the quality of the environment. The performance of

assets should be improved such that they reduce energy and water consumption, enhance social well-being and support job creation. Consideration to material selection should be focused upon regarding life cycle analysis, recyclability as well as product transparency and disposal (DPW, 2016).

4.3. Post 2015 National Energy Efficiency Strategy – first draft March 2016

The vision involves the promotion of energy efficiency as the first fuel. This will drive a socially inclusive and environmentally sustainable economic growth boosting employment and leading with technological innovation. Energy efficiency is considered to be a hidden resource that should be considered before other measures are taken (Department of Energy, 2016).

This post 2015 strategy aims to encourage continued growth in energy efficiency enabling future progress and the South African government is committed to seizing these opportunities. These possibilities exist through; improving energy security, optimising resources to safeguard environmental sustainability, improving competitiveness but also supporting local energy efficiency market opportunities and stimulating inclusive economic growth (Department of Energy, 2016).

The DoE commits to supporting households, businesses and government departments by availing affordable good quality energy efficient technologies, supporting energy efficient investments, promoting and sharing knowledge of best practice, and nurturing a vibrant energy services sector (Department of Energy, 2016).

Energy consumption in the public sector is expected to increase two fold in 2013 from 2012 levels. This can be reduced by approximately 16% through refurbishments and other inventions including efficient space heating, lighting and other improved building practices based on the current version of *SANS 10400-XA Energy Usage in Buildings*. Future intended reductions would offer greater savings. New buildings and sustainable refurbishment of existing buildings offer the greatest potential in energy savings (Department of Energy, 2016).

The strategy outlines a sectoral approach aimed at delivering the results. The goal for public sector buildings is to accelerate the current rate of improvement in the energy consumption per square meter in buildings occupied by the state at all levels. The target is a 50% reduction in specific energy consumption by 2030 relative to a 2015 baseline. The public sector aims to lead by example across all buildings either owned or leased by government (Department of Energy, 2016).

The mandatory display of Energy Performance Certificates (EPCs) in all government buildings is currently in policy stage pending legislation. This will extend to buildings rented by government on signing a new lease. Trained energy managers will be appointed at public buildings and they will ensure that energy usage is being monitored and addressed. Minimum energy performance standards (MEPS) will complement the existing mandatory labelling already in place. These will address appliances that are commonly used in the public sector

such as large scale heating and cooking appliances. Energy endorsement labels like Energy Star may be a valuable complementary addition to the existing labels already in place (Department of Energy, 2016).

The refurbishment of the existing public sector building stock will require significant investment. Partnerships between local and international energy service companies (ESCOs) will be encouraged to secure financing for large scale projects. This leads to the concept of the ESCO incubator which will facilitate the development and experience of local private sub-contractors through these larger projects.

The following section provides an overview of the implementation plan for the first five years.

Table 3. The way forward

Ref. no.	Measure	Timelines				
		Year 1 2016- 2017	Year 2 2017- 2018	Year 3 2018- 2019	Year 4 2019- 2020	Year 5 2020- 2021
PUBLIC SECTOR						
P1.1	The introduction of mandatory EPC certificates in all rented properties and publicly accessible buildings					
P1.3	Develop the public sector awareness raising campaign to facilitate the “leading by example” approach					
P1.6	Introduce standards and labelling relevant for public sector appliances and equipment					
P1.7	Announce a 15-year trajectory for the successive tightening of the energy performance component of building standards					
P1.9	Roll-out of the provision of energy and activity data from the public sector					
P2.1	Develop municipal energy efficiency strategies					
P2.2	Support the implementation of energy savings measures					

Souce: Department of Energy, 2016.

The results framework illustrated above is broken down in detail in the following table

Table 4. Measures to be implemented

MEASURES		
Description	Estimated savings	Risks and assumptions
Public buildings sector		
- Leading by example – developing the brand - Green procurement - Energy management - Innovative financial solutions - Professionalisation of ESCOs - Expansion of mandatory EPCs - Expansion of standards and labelling	10 PJ (building retrofits)	- The institutionalisation of the energy efficiency culture requires strong political commitment. If full political buy-in is not evident, the measure will not be as effective. - Green procurement can lead to higher up-front costs, causing annual procurement budgets to inflate. This may be challenging to justify in the current resource constrained context. - Facilities managers may not have a technical background and therefore will require capacity building before they are able to take on the role of energy manager. - Based on the current economic climate, the introduction of innovative investment solutions may prove challenging, specifically due to recent devaluations. - The accreditation process for ESCOs needs to be relatively simple and not too costly to encourage small to medium enterprises (SME) to invest.

Source: Department of Energy, 2016.

4.4. SANS 1544 Energy Performance Certificates for buildings – Draft 1

The SANS 1544:2014 edition 1 is still in draft format and has not yet been published as a South African Standard. The technical committee responsible for the development of the document have approved this document and reached a consensus that the document should become a South African Standard.

“The idea is that the Energy Performance Certificates (EPC) will have to be displayed on state owned buildings with the intention that the regulation be extended to cover the commercial sector by around 2020” (Hayes, *et al.*, 2016).

The standard prescribes the requirements for producing Energy Performance Certificates for existing buildings that compare the energy performance of a building to a reference energy consumption. The scope of the standard is limited to; the energy performance is based on measured energy performance, the building must be in its current operation for two years or longer and not subject to a major renovation or change in building classification, building classifications as per SANS 10400 XA, and maximum energy consumption values as per SANS 10400 XA. The standard also includes specifications for the format and layout of the completed certificate. All energy consumption data will be assessed by a body that has been accredited by the relevant national accreditation body. This is where ESCOs and the concept of the ESCO incubator will play a significant role in the process. The reference energy performance, E_r , shall be determined by the maximum energy consumption as provided for that building classification in SANS 10400 XA (SABS, 2014).

The performance scale includes seven grades ranging from A through to G with E linked to the reference energy. Exclusions include storage areas, garages and parking, outdoor areas and energy consumed by outdoor services. The nett floor area must be included separately on the certificate.

A Government Building Light House 23 Energy Street Anytown 12345		Certificate Number 123-456			
This certificate is issued in terms of SANS 1544:2014, Energy performance certificates for buildings, and indicates how much energy is being used to operate this building. The energy performance of the building is based on measured energy performance and is compared to the maximum energy consumption provided for in SANS 10400 XA.					
Energy performance certificate			(Energy performance of your building) 259 kWh/m² a		
	Not energy efficient		Energy excluded (outside net floor area) 73 kWh/m² a		
Building information: Owner: Property Portfolio (Pty) Ltd Occupancy classes: G1 – Offices Number of floors: 12 Net floor area: 2 730 m² Year of construction: 1955 Building plan approval: 1955/02/21 Occupancy certificate: 1956/05/21 Year of last major renovation: 1999 Climatic zone: 3 – Hot Interior Cadastral information: Erf 3 Farm Soutfontein		Administrative information: Accredited body: Energy Auditors Inc. Accreditation No. SANAS 98765 Assessor name: AN Assessor Date of issue: 1 July 2013 Valid until: 31 June 2018			
Carrier	From (date)	To (date)	kWh	Net floor area	kWh/m²
Electricity (grid)	2012.01.01	2013.01.01	400 000	1 000	400
Gas					
Other					

Figure 1. Format of the energy performance certificate (SABS, 2014)

4.5. SANS 10400 XA

The South African Nation Standard 10400 XA Energy Usage in Buildings is part of the 10400 suite of documents prescribed deemed-to-satisfy requirements for compliance with part XA (energy usage in buildings) of the National Building Regulations (NBR). The NBR was amended on 11 September 2011 through a short notice in the Government Gazette to include the first chapter on environmental sustainability. This was effective as of 11 November 2011. This is the minimum standard. Any other means selected to demonstrate compliance is considered a rational design or rational assessment. According to the regulation, new buildings and extensions to buildings of which plans are required to be submitted to local authority for approval, are required to comply.

Regulation XA1 indicates that if buildings and extension to buildings are to contribute to the reduction of greenhouse gas emissions, they should be designed and constructed such that they are capable of using energy efficiently. XA2 prescribes at least 50% by volume of the annual hot water heating requirement be provided by means other than that of electrical resistance heating. The South African National Standard 10400 XA Energy Usage in Buildings provides the deemed-to-satisfy requirements to comply with the National Building Regulation XA. The four requirements addressed in the standard include; hot water supply, energy usage and building envelope, design assumptions and building envelope requirements.

Annexure 1 to the standard include the climatic zones for South Africa. Six climatic zones have been identified across the country and the requirements for compliance vary according to region. The six regions are categorised; cold interior, temperate interior, hot interior, temperate coastal, sub-tropical coastal and arid interior (SABS, 2011).

4.6. SANS 204

The South African National Standard 204 Energy Efficiency in Buildings is the standard that specifies the design requirements for energy efficiency in buildings and services. This is applicable to both new buildings that are ventilated naturally as well as those that are mechanically ventilated. This is a voluntary standard and a minimum requirement for Green Star South Africa (GSSA) rating. According to the South African Bureau of Standards (SABS) the main principle underpinning the development of this standard was the potential significant savings in energy that residential and commercial buildings presented (SABS Standards Division, 2009).

Table 5. SANS 10400 XA and Sans 204 requirements

requirements	SANS 204	SANS 10 400-XA
Floor insulation	✓	✓
Perimeter insulation	✓	✗
Raised floor insulation	✓	✗
Roof Assemblies	✓	✓
Pipe Insulation	✓	✓
Masonry Walls insulation	✓	✗
Non-masonry walls insulation	✓	✓

Souce: Saint-Gobain, SSA, 2013.

The standard's key areas include; site orientation, building orientation, building design, building sealing, services and mechanical ventilation, and air-conditioning. This standard is made indispensable for compliance with the regulations as the SANS 10400 suite of documents makes a number of references to SANS 204 (Tucker, 2017).

4.7. Green Building Norms & Standards WP3: Existing Buildings - Draft 2

This document is still in draft form. The norms and standards have been developed to meet the following objectives; provide guidance to achieve sustainable, responsible building design, operation and management of buildings owned, occupied or operated by the department, to define minimum levels of compliance, offer performance based or prescriptive requirements to achieve a level of sustainability that exceeds that of the National Building Regulations and to establish best practice for sustainable design and construction (DPW, 2017).

The Green Building Norms & Standards developed for the department of Public Works follows from the development of the Green Building Policy for Public Works. This supports the increasing awareness related to the role of the built environment toward a green economy. The National Development Plan have identified areas where the built environment plays a supporting role toward achieving a zero carbon energy efficiency standard by 2030 (DPW, 2017).

The norms and standards are applicable to new buildings as well as maintenance, additions and alterations of existing buildings. These would also include refurbishments to existing buildings. These norms and standards are aimed at assisting the department align their approach to their own property portfolio in appropriately responding to climate change, resource efficiency, energy efficiency and unemployment in the country (DPW, 2017).

Chapter four of the document focuses on material resource conservation and efficiency. It sets out requirements for material conservation, resource and energy efficiency and environmental performance. These measures include; minimising the consumption of natural resources, avoiding and minimising the generation of waste, reduce, reuse, recycle and recover waste, treat and safely dispose of waste as a last resort, prevent pollution and ecological degradation, secure ecologically sustainable development while prompting economical social development, promote and ensure the effective delivery of waste services, rehabilitation of land where required and achieve integrated waste management reporting (DPW, 2017).

Materials and products that have an eco-label will be preferred and specified. Locally manufactured materials and products will be preferred over imported equivalents in order to minimise transport impacts. For additions and alterations projects or where repairs are required, these should be done with the intention of disassembly at end of life in order to

minimise demolition waste and directing waste to landfill. Space planning should be developed to allow for efficient changes in layouts as the space requirements evolve over time.

Chapter five of the document addresses energy efficiency. Buildings should be designed in a manner that responds to the local climate. Passive design principles are encouraged especially regarding wind, precipitation, humidity and temperature. Energy metering will be required at new and existing buildings. The purpose of energy metering is to create awareness related to consumption as well as facilitating the development of EPCs.

Building renewable energy systems are encouraged. A percentage of the electrical supply shall be provided by a renewable on site source which will be agreed and determined by the departments and stated in the tender and briefing documents.

Chapter six addresses water conservation and efficiency. Fixtures and fittings will be compliant to SANS 10400 XB and water meters shall be installed to monitor consumption in new and additional areas of the building. Rainwater and greywater collection and distribution systems solutions shall comply with a pending South African National Standard.

Indoor environment air quality and comfort provisions support a healthy indoor environment where indoor air pollutants and other contaminant are reduced. HVAC systems should be designed in a manner that facilitates cleaning and maintenance. Acoustic comfort is prescribed through addressing the performance of separating assemblies, reverberant energy, flanking sound and ambient noise levels. Indoor air quality draws to a conclusion with daylighting and minimum daylight factor.

4.8. Maintenance Management Standard National Immovable Asset Maintenance Management

This standard establishes a system of principles and specifications for the management and care of immovable assets after initial design and construction or acquisition. The purpose is to derive maximum benefit from these assets, to protect the investment of the public sector, to support economic development, social upliftment and environmental sustainability as well as to ensure robust practises are implemented by the facility's management teams (DPW & CIDB, 2017). Maintenance and renewal form part of lifecycle management of assets and the lifecycle of assets should be managed comprehensively and holistically. The standard is applicable to all forms of public sector immovable assets.

The standard highlights key characteristics of public sector immovable assets. They contribute to the fixed capital wealth of the country, form the foundation for economic activity and enable the delivery of social goods. They have been in existences for generations and display longevity. Each generation entrusts the government of South Africa as custodians of this

property portfolio. The government in turn has an obligation to maintain the value and productive capacity of the public immovable assets (DPW & CIDB, 2017).

Immovable assets must be maintained periodically in order to achieve their useful life expectancies. However, maintenance only slows down the process of deterioration. Sustainable refurbishment and capital renewal is required to serve the period of indefinite demand.

The extent of the portfolio of public sector buildings have the significant potential of consuming vast amounts of energy and water as well as generating vast amounts of waste during operation and churn. New technologies and a sustainable refurbishment approach have the potential of reducing energy and water consumption as well as a reduction in waste generation all in support of sustainable development. There is significant scope for green retrofitting or sustainable refurbishment and the associated social, economic and environmental benefits.

4.9. Maintenance Monitoring and Evaluation Protocol

This document describes the protocol to monitor and evaluate the implementation of the Maintenance Management Standard National Immovable Asset Maintenance Management. The focus of the protocol is to ensure appropriate asset care through investment in maintenance and refurbishment, assess the suitability and effectiveness of the maintenance management system and adjust accordingly, and to introduce the State of Public Works Asset Report. This will provide a national view on the state of the assets as well as noting of the requirements as well as described advances in the progressive greening of public sector existing buildings (DPW & CIDB, 2017).

Section two provides entity level asset care performance measures. These measures focus in the state of the assets and the adequacy of spending on these refurbishments and maintenance. Section three provides monitoring and maintenance reporting related to the maintenance management system. An asset care performance measure focusing on green renewals is included. The National Immovable Asset Maintenance Standard supports the objective of environmental sustainability as indicated in the; National Environmental Management Act, the National Energy Efficiency Strategy of the Republic of South Africa, the National Climate Change Response paper and the Green Building Policy (draft). Green component and technology replacing offers the constant and continuous mechanism for greening of the existing public sector building stock. The green renewals agenda ratio provides a ratio between the size of the renewal and the extent of the expenditure (DPW & CIDB, 2017).

4.10. National Climate Change Response White Paper

There are two main objectives to South Africa's response to climate change and these are; to effectively manage the inevitable impacts of climate change and to make a fair contribution to the global efforts of reducing greenhouse gas emissions (DEA, 2012). The South African government acknowledges the effects of climate change on its people, environment and

economy and accepts the conclusions of the Intergovernmental Panel on Climate Change 4th assessment report, acknowledges climate change as one of the greatest threats to sustainable development and ratified both United Nations Framework Convention on Climate Change (UNFCCC) as well as the Kyoto Protocol (DEA, 2012).

Generally, responses to climate change are either adaptive or responsive in nature. South Africa's response is described as environmental, economic and social responses that integrate both adaptive and mitigation strategies in a development framework. This strategic response is termed a "climatic change resilient development" (DEA, 2012).

South Africa's overall adaptation response is based on risk and vulnerability reduction. Damages from unmitigated climate change could range from 5% to 20% of South Africa's GDP by 2100 (DEA, 2012). The adaptation responses include those focused on; water, agriculture and forestry, health, biodiversity and ecosystems, human settlements (urban, coastal and rural), disaster risk reduction and management.

The mitigation approach is informed by two key criteria; South Africa's contribution as a global participant in the reduction of global emissions strategy and South Africa's management of poverty eradication. A climate change response is a cross generational challenge. The effects of the strategies considered and implemented at this time will not necessarily deliver immediate measurable results but may have a significant effect on future generations (DEA, 2012).

4.11. Summary

Industry experts were engaged with during the investigation process and their suggestions and recommendations sought related to the aim of the study. Current policies, guidelines, frameworks and standards were referred to and suggested for review to support an understanding of the local context in terms for existing guidelines. These included; DPW green building policy, Post-2015 National Energy Efficiency Strategy – first draft March 2016, Green Building Norms & Standards WP3: Existing Buildings - Draft 2, SANS 1544 Energy Performance Certificates for buildings – Draft 1, SANS 10400 XA, SANS 204, Green Building Norms & Standards WP3: Existing Buildings - Draft 2, Maintenance Management Standard. National Immovable Asset Maintenance Management, Maintenance Monitoring and Evaluation Protocol and National Climate Change Response White Paper. South Africa has a relatively well developed climate change and energy efficiency policy framework in place.

Chapter 5: Research Methodology

5.1. Introduction

Research can be described as the organised and systematic approach to finding answers to questions. There should be clear and logical steps that lead to objective conclusions. Research is driven by specific questions. The design articulates what data is required, how the data is to be collected and the manner in which the data will be analysed in order to answer the research question (Holden & Lynch, 2010). Research is employed to increase or add to current knowledge through discovering new facts (Rajasekar, *et al.*, 2013).

5.2. Case study approach

In order to solve a research problem a research approach has to be chosen. The type of approach that is appropriate depends on the research questions under investigation as well as the knowledge of the researcher within the field of study. Although there are distinct differences between the positivist and phenomenological world views the reality of research also involves a lot of compromises between these pure positions (John, 2016).

The study adopts a qualitative research approach. The qualitative approach is appropriate to address the research questions under investigation. This qualitative research approach primarily focusses on semi-structured interviews as a data collection technique as well as recording the experiences of experts in the field. The data collection process will be non-standardised and data will emerge through the process naturally (Saunders, *et al.*, 2016).

The research methodology adopted is that of a case study method. Yin (2009) defines a case study as “an empirical inquiry that investigates a contemporary phenomenon in depth and within its real life context especially when the boundaries between phenomenon and context are not clearly evident” (Yin, 2009).

According to Merriam (2009), case studies are anchored in real life situations. A case study approach results in a rich and holistic account of a phenomenon. It expands the researcher’s experiences by offering insights and highlighting meanings. The insights could lead to future research – consequently, the case study research method plays an important role in advancing a field’s knowledge base (Merriam, 2009). Case study research uses quantitative or qualitative research and often adopts a mixed method approach to fully understand the dynamics of the case (Saunders, *et al.*, 2016).

The aim of the study is to identify the contextual barriers and opportunities pertinent to the sustainable refurbishment of existing commercial and public sector office buildings in the inner city area of Johannesburg, South Africa. The case study approach allows the researcher an empirical inquiry that investigates the refurbishment processes in depth and within real life contexts in different scenarios and cases. The case study approach allows for rich and holistic accounts of the interactions between stakeholders and factors that influenced decisions during the refurbishment of existing buildings. These interactions and influencing

factors can then be analysed across cases and yield contextual barriers and opportunities pertinent to the sustainable refurbishment of existing buildings (Saunders, *et al.*, 2016). Based on this insight a case study approach was selected as an effective approach to this study.

5.3. Case study strategy

Yin's (2009) three conditions were also considered when selecting the research strategy. These three conditions are; the type of research question posed, the extent of control an investigator has over actual behavioural events, and the degree of focus on the contemporary as opposed to historical events (Yin, 2009). Some "what type" questions are exploratory such as, "what are the contextual barriers and opportunities pertinent to the sustainable refurbishment of existing commercial and public sector office buildings in South Africa?" This type of question is suitable for an exploratory study. Any of the five research strategies could be used as an exploratory study (Yin, 2009). The research strategy selected in this study is that of an exploratory case study. Experiments typically require controlled environments which are not feasible in this study. Surveys may not be effective in gaining the depth required, therefore are unfeasible in this study.

A contention raised against case study research is that the researcher cannot generalise from case study research and a single case cannot contribute to scientific development. According to Flyvbjerg (2006), one can often generalise on the basis of a single case. The choice of research method should depend on the problem being addressed. Case study method could be central to the research or it could be supplementary to other research methods. Generalisation may be overvalued and the "force of example" may be underestimated (Flyvbjerg, 2006). In the book titled, "Five misunderstandings of case study research", Flyvbjerg (2006) explains and addresses each one of these misunderstandings. These misunderstandings include; theoretical knowledge is more valuable than practical knowledge, one cannot generalize from a single case, therefore, the single-case study cannot contribute to scientific development, the case study is most useful for generating hypotheses, whereas other methods are more suitable for hypotheses testing and theory building, the case study contains a bias toward verification, and it is often difficult to summarize specific case studies. The article concludes by repeating a Thomas Kuhn insight. A discipline without a large number of well executed case studies is a discipline without exemplars. A discipline without exemplars is an ineffective one (Flyvbjerg, 2006). Based on this insight a case study approach was selected as an effective approach to this study.

Comparative case studies emphasise comparison within and across contexts. They involve the analysis and synthesis of the similarities, differences and patterns across two or more cases that share a common goal. A comparative case study approach is selected for this study because this method can be used to understand causal relationships across cases and usually use both qualitative and quantitative methods. Comparative case studies are also useful in explaining and understanding contextual influences of successes of an intervention. This leads

to understanding how best to tailor the intervention to suit the specific context in order to achieve the desired outcomes (Goodrick, 2014).

Specific features of each case have been described in depth at the beginning. This study addresses three cases; leased buildings occupied but not owned by government, buildings occupied and owned by government and government owned buildings that are to be refurbished through a public private partnership model. This is linked to key evaluation questions which are high level questions aimed at evaluating the overall performance. Data collection methods included; fieldwork visits, observation, interviews and document analysis (Saunders, *et al.*, 2016).

A main point of the comparative case study approach would be to explain how the three different contexts (leased buildings occupied but not owned by government, buildings occupied and owned by government and government owned buildings that are to be refurbished through a public private partnership model) influences the success of a refurbishment process. Identify the contextual barriers and opportunities within the cases and consider how to tailor the refurbishment process to achieve the intended outcomes if possible or practical. It is assumed that a single preferred case may emerge.

This study follows six steps according to Goodrick (2014) in *Comparative Case Studies*. These are; clarify the key evaluation questions and purpose of the evaluation, identify initial propositions or theories, define the type of cases that will be included and how the case study process has been conducted, identify how the evidence has been collected, analysed and synthesised in each case and across all cases, consider and test alternate explanations for the outcomes and lastly report the findings (Goodrick, 2014). The cases have been conducted concurrently.

The research includes case studies of building refurbishment projects. Local case studies of building refurbishment projects have revealed valuable data regarding the building performance before refurbishment, related to energy and water use. There has been an opportunity to gather user/occupant feedback through interviews. The three types of interviews include; structured, semi-structured and unstructured. Semi-structured interviews offer a flexible balance between structured and unstructured. It provides the opportunity to probe deeper as well as redirect the engagement when required (Saunders, *et al.*, 2016). The before and after performance data have demonstrated the opportunity that sustainable refurbishment of existing buildings present. Case studies have revealed technologies implemented and the benefits gained.

5.4. Research philosophy

Differing sociological perspectives exist within research. It has been suggested that assumptions about the nature of science can be addressed through two dimensions. These are called the subjective-objective dimension. The nature of society can be addressed in terms

of a regulation – radical change dimension (Burrell & Morgan, 1979). “Objectivism and subjectivism have been described as a continuum’s polar opposites with varying philosophical positions aligned to and in-between them” (Holden & Lynch, 2010). Associations with objectivism include; quantitative, positivist, scientific and experimentalist whilst associations with subjectivism includes; qualitative, phenomenological, humanistic and interpretivist (Holden & Lynch, 2010). Two main contrasting research philosophies are phenomenology and positivism. The assumptions behind the two philosophies; phenomenology and positivism are significantly different. The role of the researcher is different as well as the interpretation of literature, collection of data and analysis (John, 2016).

The system of positivism maintains that knowledge is about description rather than questioning. Positivists recognise only factual data and observable events, those things that can be seen, measured and counted as fact (Falconer, *et al.*, 2007). It is descriptive research and asks the question of what is going on.

Phenomenologists are more concerned with what things mean rather than just identifying and measuring data and events. They are interested in the idea that human experience is an important source of data (Falconer, *et al.*, 2007). It is explanatory research and asks the question of why it is going on.

There are significant differences between the two philosophies across select categories which include; basic notions, responsibilities of the researcher, most suitable research methods and sampling. The positivist paradigm views the world as objective and external, independent of the researcher whereas the phenomenology paradigm perceives the world is socially constructed and subjective where human interest drives science. The responsibility of the positivist researcher would be to focus on fact. The phenomenologist would focus on meaning and the meaning of events. The sample size would have to be large for the positivist and the phenomenologist would spend a greater amount of time analysing small samples in great depth (John, 2016).

5.5. Theoretical perspectives

This is a set of assumptions about reality. They inform the questions asked but also guide the answers arrived at as a result. It can be understood as a lens through which information is filtered or focused. It can also be described as a frame through which the problem is viewed. This frame includes and excludes information based on the individual’s perspective (Crossman, 2016).

Some of the major theoretical perspectives include; functionalist perspective, conflict perspective and interactionist perspective. Functional perspective can be viewed as a system of inter-related parts performing unique functions to maintain balance of the system. The individual parts may be performing different roles but the common goal is stability of the system as a whole. A critique of functionalism is that it is inherently conservative, therefore change is viewed as a negative consequence (Long, 2014). Conflict perspective views society

as less cohesive and rather an arena for power and conflict struggles. Individuals achieve their will at the expense of others and there is competition for scarce resources. Where a functional system exists for the good of the entire system, the conflict system interacts to serve the interests of the powerful. The interactionist perspective takes the view that it is people who exist and act. All other structures are human creations. The system is dynamic and change occurs as a result of interaction between individuals (Long, 2014).

This study benefits from a functionalist perspective view. There are a number of stakeholders that are required to contribute toward maintaining the balance of the system. These included designers, tenants, owners, landlords, contractors, installers, quantity surveyors and building occupants. Policy and legislation (voluntary and mandatory) are also contributors that are valuable in order to attain the aim which is to identify the relevant compliance considerations related to the refurbishment of existing buildings in South Africa. Mentioned earlier, sustainable development refers to the integration of social, environmental and economic factors into planning and implementation strategies. This is done to ensure that future generations are able to meet their needs and aspirations.

5.6. Modernism and postmodernism in research

Postmodernism in research has been developing since World War II. It privileges no single authority, method or paradigm. Boundaries are now blurred between the elite and the popular and between art and life (Hughes, 2010). The modernist approach was predominant prior to the 1950's. It was based on knowing through the senses first and then developed to knowing through science and then reason and logic (Hoffman, 2008). Postmodernism was initially a reaction to the Modernism style of architecture developed after World War I. It then became a philosophy which assumed the task of banishing all modernists' paradigms. Modernism masked itself in a world of objectivity and rationalism, placing all other perspectives as irrational and subjective. "Postmodernism rejects the concepts of a rationally structured universe of modernism, while supporting the idea that reality is much more complex than modernists would have individuals believe" (Kaya, 1999). The root of postmodernism is the search for differences rather than similarities; hence the world having order is instantly dismissed (Kaya, 1999).

The refurbishment process conceals a degree of unpredictability in its execution. The scale of the project and intervention as well as the design and construction may guide the method and the solutions which are to be applied. This may require a flexible approach as refurbishments from one commercial project to the next may vary significantly. The refurbishment process could be complex depending on the project circumstances. The type of building, location, current state, target state as well as the various stakeholders all result in a unique and relatively complex process.

5.7. Data collection

Research can be described as the organised and systematic approach to finding answers to questions. There should be clear and logical steps that lead to objective conclusions. Research

is driven by specific questions. The design articulates what data is required, how the data is to be collected and the manner in which the data will be analysed in order to answer the research question (Holden & Lynch, 2010). Research is employed to increase or add to current knowledge through discovering new facts (Rajasekar, *et al.*, 2013).

Data collection is a systematic approach to gathering and measuring information from a variety of sources to get a complete and accurate picture of the area of interest. Data collection allows for answering of questions, evaluating outcomes and predicting future trends (Goulart, 2016). Data collection can be described as putting the research design into operation. There are a number of methods of collecting data and the research observers will select a method or combination of methods and implement the research plan (Rabinowitz & Fawcett, 2016). Methods of data collection include; census, sample surveys, experiments and observational study. A census is a study that contains information from every member of a population. This is usually unfeasible as it requires extensive time and resources. A sample study includes data extracted from a subset of a population. This data will provide an estimate of the populations' attributes. An experiment is a controlled study in which the researcher aims to understand cause and effect relationships. The researcher has control over the sample groups and which treatment each groups receives. Observational studies are similar to experiments as they also aim to understand cause and effect relationships. Observational studies are different from experiments as the researcher does not have control over the research groups nor which treatment each group receives (Berman, 2016).

The research included interviews with industry experts including those at the Gauteng Department of Infrastructure Development (GDID) as well as architects, designers and specifiers. Interviews aimed at public sector employees would extract the current state of the existing building stock as well as present the target state. This resulted in a formulation of a gap analysis. The gap analysis highlighted the barriers and present the opportunities for sustainably refurbishing the existing building stock. The gap analysis also highlighted the various stakeholders and the complex decision making process in a refurbishment project.

The research paper titled, "A preliminary exploration of the barriers of sustainable refurbishment of commercial building projects in Malaysia", collected qualitative data primarily through semi-structured interviews with industry experts like building managers in Kuala Lumpur (Masrom, *et al.*, 2017).

Interviews with industry experts other than those at the Gauteng Department of Infrastructure Development (GDID) would reveal the current state of the development of South African policy regarding sustainably refurbishing existing buildings. It is envisaged that this also revealed current state and next steps for the pending legislation regarding refurbishing of existing buildings.

5.8. Data Analysis

Data analysis refers to a process where raw data is converted to information useful for decision making by users. Data is collected and analysed and used to test theories, disprove theories and answer questions (Bala, 2005).

Quantitative data is always numerical and is analysed using numerical or statistical methods. Typically, quantitative data asks the question of “what happened”. Qualitative research typically does not include numbers. It often includes words or language but may include pictures, photographs or observations (Marley, 2011). Qualitative data usually provides an in-depth picture and is useful in answering how and why events took place. The first step after data collection is to summarise and present it in a manner that best reveals the trends or results. The data could be grouped into specific categories and presented as graphs that best display the data. Graphs present an immediate picture of the results and will highlight groupings of maximums, minimums, medians and outlying results (Marley, 2011).

“Data analysis is an ongoing activity, which not only answers your question but also gives you the directions for future data collection. The uses of such procedures put your research project in perspective and assist you in testing the hypotheses with which you have started your research” (Bala, 2005).

The results of qualitative data collection will often be in the form of words. Various systems of analysing data could be employed and this will depend on the philosophy that underpins the research as well as skill and preference. Six main systems for data for language based data analysis are identified; content analysis, grounded analysis, social network analysis, discourse analysis, conversational analysis and narrative analysis (Marley, 2011).

A summary of a particular aspect or issue related to the research is useful for creating context and introducing the idea or concept. The detail then follows as this provides a coherent sequence of events leading up to the finding. Quantitative data demonstrating the effects of design, construction, operation and demolition of the built environment could be clearly presented through graphs, diagrams or infographics. This type of data and medium of presentation could also identify trends related to sustainable development and mechanisms for change. Connections or parallels could be drawn between global and local trends related to sustainable development within the built environment. A desktop analysis documenting local case studies of refurbishment projects could support the position of emerging trends in the built environment locally. Semi-structured interviews with industry experts are required to present a first-hand view of the current context and the framework for change together with implementation strategies.

The findings within each topic or aspect of research would be converted from raw data to actionable information. This has been done through the data analysis phase. The findings have been objectively presented and the results would yield the challenges and barriers pertinent to the sustainable refurbishment of existing buildings.

Data is more usable when it is arranged in categories. The research question and sub questions will inform the categories (Saunders, *et al.*, 2016). Data collected from the case studies have been analysed using content analysis. Content analysis is effective in using an entire dataset to identify underlying themes that may be presented through the data. This is a similar approach to that of Masrom, *et al.*, (2017).

Interview data has been recorded and analysed using the content analysis method and a summary for each case study is presented. The summary highlights the critical factors, challenges and opportunities pertinent to the sustainable refurbishment of existing buildings in Johannesburg, South Africa. The analysis of the individual case studies is followed by a cross case study analysis. This cross case study analysis highlights the trends and commonalities across the cases.

Meetings were held with industry experts over the course of a few months. These experts included, built environment experienced professionals, sustainability consultants, and researchers. All bar one of these individuals were participating and contributing to SANS (South Africa National Standards) development, focusing on the built environment at some point within the last decade and select individuals are still currently engaged with same.

5.9. Identification of themes

Theme identification is one of the most fundamental tasks in qualitative research. Explicit descriptions are rarely available. At times, theme discovery is relegated to appendices and footnotes (Ryan, 2003). Analysing text involves several tasks; discovering themes and sub-themes, winnowing themes to a manageable few, building hierarchies of themes and linking themes into theoretical models. Different techniques have different advantages and disadvantages. Some methods are suited to complex conversations while others are suited to short responses and questions (Bernard & Ryan, 2003). Themes are described as being visible through the manifestation of expressions in data. Expressions are meaningless without some reference to themes. Some themes are obvious while others are subtler and simpler. The importance of any theme is related to many factors (Bernard & Ryan, 2003). Coding is the process of identifying themes in accounts and attaching labels to index them. Themes are often identified when they recur several times in a particular text but this is not the rule as they can also be identified as a single comment from a particular participant. Themes are not hiding in data waiting to be discovered but rather they emerge as a result of the engagement of a researcher with the text (Ryan, 2003).

An analysis of the green building environment in the public sector with a focus on existing office buildings may produce themes that could direct toward trends. Themes may also emerge through collating the relevant policies and frameworks, and identifying the goals and objectives. The intention is to note and analyse the emergence of these themes. The themes may emerge within the individual case study or they may emerge during cross case analysis. A coding frame has been developed and this is used to analyse the data obtained from the semi-structured interviews.

5.10. Sampling in research

Sampling is a smaller but representative collection of units from a population used to generate or reveal truths about that particular population (Chaturvedi, 2015). Sampling offers reductions in both time and money, and delivers result with known accuracy that can be calculated mathematically. Identify the population of interest but also identify to whom the results are to be generalised to (Chaturvedi, 2015). A sample is expected to mirror the population from which it is extracted but this is not always guaranteed. A few scenarios exist that affect the results and these include; sampling errors, measurement errors, the interviewers effect, the respondent effect, knowing the study purpose and induced bias. These are some of the common challenges associated with statistical studies and could be minimised through careful consideration of the selection of the sampling procedure (Fridah, 2002).

“There are three primary kinds of samples: the convenience sample, the judgement sample, and the random sample (Fridah, 2002). They differ in the manner in which the elementary units are chosen” (Fridah, 2002). A convenient sample results when the more convenient elementary units are chosen from a population for observation. A judgement sample is selected by somebody who is familiar with the characteristics of the population. A random sample allows a probability that each known elementary unit of the population could be selected, hence frequently referred to as a probability sample (Fridah, 2002). Types of random samples include; simple random sample, systematic random sample, stratified sample and cluster sample (Fridah, 2002).

A significant difference between quantitative and qualitative approached is the logic that underpins the sampling approaches. Qualitative inquiry focuses on an in-depth analysis of relatively small samples, selected purposefully. The driver behind purposive samples is the requirement for information rich cases for in depth study (Patton, 1990). Information rich cases provide a great deal of knowledge which is of central importance to the purpose of the study. “There are several different strategies for purposefully selecting information-rich cases. The logic of each strategy serves a particular evaluation purpose” (Patton, 1990). Purposive sampling strategies include; extreme or deviant case sampling, intensity sampling, maximum variation sampling, homogenous sampling, typical case sampling, stratified purposeful sampling, critical case sampling, snowball or chain sampling, criterion sampling, theory-based sampling, confirming and disconfirming cases, opportunistic sampling, random purposeful sampling, sampling politically important cases, convenience sampling and combination or mixed purposeful sampling (Patton, 1990).

This research has focused on the qualitative approach. Information rich cases for in depth study may be most effective in analysing the green building environment in the public sector, with a focus on existing office buildings. These information rich case studies have provided a great deal of knowledge which is of central importance to the purpose of the study of

identifying the contextual barriers and opportunities pertinent to the refurbishment of the existing buildings in Johannesburg, South Africa. It may provide the ideal case for sustainable refurbishment when measured against the existing buildings as a benchmark or reference.

The three types of cases selected are based on the three current scenarios of refurbishment of existing buildings experienced by the Gauteng Department of Infrastructure Development (GDID). This study has addressed these three cases; leased buildings occupied but not owned by government, buildings occupied and owned by government and government owned buildings that are to be refurbished through a public private partnership model.

5.11. Validity and Reliability

An important part of social research is the measurement of and quantifying of human behaviour and responses. Therefore, measurement instruments have to be valid and reliable. Reliability is described as the extent to which measurements can be repeated. Reliability in research would result in the same data gained from different persons performing measurements on different occasions under different conditions (Drost, 2011). It is the consistency of measurement or the stability of measurement over a variety of conditions (Drost, 2011; Saunders, *et al.*, 2016).

Validity is concerned with the meaningfulness of the research components. Validity refers to the problem of whether that which is being measured is actually that which was intended to be measured (Drost, 2011; Saunders, *et al.*, 2016).

From the qualitative researcher's perspective, the traditional meaning of reliability and validity is somewhat different or slightly changed. Reliability and validity are conceptualised as trustworthiness and quality in the qualitative paradigm (Golafshani, 2003). Through this association the means to achieve reliability and validity from the qualitative researcher's perspective gets affected as one has to eliminate bias and increase truthfulness of a proposition about some social phenomenon using triangulation. Triangulation is described as a validity procedure where the researcher searches from multiple and different sources of data for themes and categories in a study (Golafshani, 2003). Data from interviews as well as project documentation have been collected and analysed in this study. Different sources of evidence from different cases have provided information from different perspectives concerning the same issue.

Reliability in the study would be addressed by considering the three types of bias that could occur during the interview process. These are interview bias, interviewee bias and participation bias (Saunders, *et al.*, 2016). Projects of similar scale and scope should be grouped together to ensure more reliable findings. Policies and frameworks should be analysed objectively and peer review may also be considered.

Validity in the research should be tested through regular feedback loops. This may present the opportunity to test that what was measured, was actually intended to be measured

before proceeding too far along with the study. Face to face interviews are also preferred relative to telephone interviews when considered from a validity perspective. Face to face interviews have been selected for this study.

5.12. Ethics in Research

The word “ethics” has its origins in Greek “ethos” which translates to one’s character or disposition (Kitchener, 2000). Today it refers to the manner in which people should act, judgements about those actions and developing rules for justifying actions (Kitchener, 2000). A common manner of describing ethics in research is norms for conduct that distinguish between acceptable and unacceptable behaviour. People learn ethical norms during childhood, at school and other social settings (Resnik, 2015). People learn to distinguish between right and wrong during childhood but moral development occurs throughout life, and humans pass through different stages of growth as they mature. Ethical norms cannot be mistaken for common sense. Many people may agree and recognise the same ethical norms but may interpret, apply and balance them in light of their own life experiences. An example would be the understanding of what it means to be human as a lens through which the commonly accepted view that the murder of an unborn baby is wrong is viewed (Resnik, 2015).

The following are recommendations of concepts to be considered to assist researchers minimise ethical predicaments; discuss intellectual property frankly, be conscious of multiple roles, follow informed consent rules, respect confidentiality and privacy, and tap into ethics resources (Smith, 2003). All researchers should be familiar with the basic understanding of what is considered ethical research practices. It is the researcher’s responsibility to be current with policies and procedures that guide ethical research behaviour. This is important because even if a single part of the research is isolated for scrutiny as a result of questionable ethical behaviour, the entire body of the research’s validity is called into question (Paul, *et al.*, 2003). *A Guide to Research Ethics* (Paul, *et al.*, 2003) highlights similar concepts as Smith (2003). These include; authorship, plagiarism, peer review, conflicts of interest, data management, research misconduct, research with animals and research with human subjects (Paul, *et al.*, 2003).

Those conducting research should follow codes of ethics when confronted with ethical challenges. Good ethical practice requires the researcher to act with integrity and honesty at all times during the course of the research (Saunders, *et al.*, 2016).

This study aims to be compliant in terms of ethical research practices through familiarisation with the basic policies and procedures that guide ethical research behaviour. This study is considerate toward any conditions of participants and does not intentionally breach any agreement or research conduct guidelines. This study is a passion of the researcher and a welcomed opportunity by a sponsor and this motivates an absolute ethical research journey.

All names of respondents have not been disclosed and their identity is anonymous. Participants have been provided with clear context of the study and the need for their participation has been explained. No pressure to participate in the interview was affected onto the intended participants. Participants have been made aware of their right not to participate or to cease participation during the process whenever the participants feel the desire to do so. Participants have been offered a copy of the study once complete, if required.

5.13. Summary

This chapter introduces research methodology in general before discussing the case study approach. The case study approach is described and this research aim is highlighted. The applicability of the case study approach to this study is made before advancing to the case study strategy. The case study strategy references authorities in field and highlights how this research method is applied to the research problem in general and in this particular instance. The data collection method for this study is described as well as the data analysis process. The identification of themes is expounded upon and the literature review highlighted specific themes evident in this study. This chapter explains why the selected case study method was chosen and how it is applied to the research problem.

Chapter 6: Case Studies

According to Merriam (2009), case studies are anchored in real life situations. A case study approach results in a rich and holistic account of a phenomenon. It expands the researcher's experiences by offering insights and highlighting meanings. The insights could lead to future research, hence the case study research method plays an important role in advancing a field's knowledge base (Merriam, 2009). Case study research uses quantitative or qualitative research and often adopts a mixed method approach to fully understand the dynamics of the case (Saunders, *et al.*, 2016).

The aim of the study is to identify the contextual barriers and opportunities pertinent to the sustainable refurbishment of existing commercial and public sector office buildings in the inner city area of Johannesburg, South Africa. The case study approach allows the researcher an empirical inquiry that investigates the refurbishment processes in depth and within real life contexts in different scenarios and cases. The case study approach will allow for rich and holistic accounts of the interactions between stakeholders and factors that influenced decisions during the refurbishment of existing buildings. These interactions and influencing factors can then be analysed across cases and yield contextual barriers and opportunities pertinent to the sustainable refurbishment of existing buildings (Saunders, *et al.*, 2016).

6.1. Case Study 1: The Kopanong Precinct

6.1.1. Introduction

The Gauteng Property Management Entity is responsible for managing and maintaining the existing government owned assets in the province. The focus is on creating a sustainable and relevant property portfolio where each asset is maintained at all times. According to the asset register, 30 000 government owned assets exists in Gauteng. The Kopanong precinct project exists amongst the development projects (GDID, 2015).

The project aims to create economies of scale in all areas for government departments. The precinct lies within a demarcated area within the Central Business District (CBD). The project enables increased interdepartmental efficiencies through communication leading to increased service delivery. An added advantage is the urban regeneration that this project presents and stability of occupancy which comes with ownership (GDID, 2015).



Figure 2. Aerial location view of Kopanong precinct

(The Heritage Portal, 2017).

6.1.2. Project description

As part of the provincial mandate, the Kopanong precinct was identified as a key project providing office space for government departments within close proximity to each other. The overall aim is to share resources and reduce duplication of activities thereby increasing communication between the various government departments (GDID, 2015).

The Kopanong Precinct Project viability study is undertaken as a public-private partnership process by the Gauteng Department of Infrastructure Development and the Gauteng Funding Agency (GFA). This is registered with the national Department of Treasury (GDID, 2015).



Figure 3. Aerial view of the precinct. See Figure 4 for building names.

(The Heritage Portal, 2017).

6.1.3. Project scope

Initially the scope included the refurbishment of 12 existing buildings. This was revised to 19 and adjusted again to include 18 buildings in the central business district (CBD). The estimated project cost is R7.8 billion (GIFA, 2017). Under the Public Private Partnership (PPP), GDID will not directly incur any of the capex costs but will rather pay an annual unitary payment to the private sector PPP partners over a period of 22 years which covers all capex and operating costs. In essence, the project is effectively being seen as a Design Build Operate Transfer (DBOT) project.

The first phase involves the refurbishment of abandoned buildings and this would require at least two years. Phase 2 would be the refurbishment of occupied buildings. The extent of the project spans 350 000 m² gross building area (GBA) and 200 000 m² gross leasable area (GLA). This project will affect more than 14 government departments and 12 000 people within the precinct. Amenities include an events plaza, activated edges containing restaurants, cafes and bars (The Heritage Portal, 2017). The project ranges between five and seven clusters and each cluster will be high value in the range of several hundred million rands.

The user government departments affected at the Kopanong Precinct Project are listed below:

1. Co-operative Governance and Traditional Affairs (COGTA)
2. Community Safety (GDCS)
3. Social Development (GDSD)
4. Economic Development (GDED)
5. Department of Health (GDoH)
6. Education (GDE)
7. Infrastructure Development (GDID)
8. Gauteng Provincial Treasury (GPT)
9. Finance (GDF)
10. Office of Premier (OoP)
11. Roads and Transport (GDRT)
12. Agriculture and Rural Development (GDARD)
13. Sports, Arts, Culture and Recreation (GDSACR)
14. Human Settlement (GDHS)



Together, Moving Gauteng City Region Forward

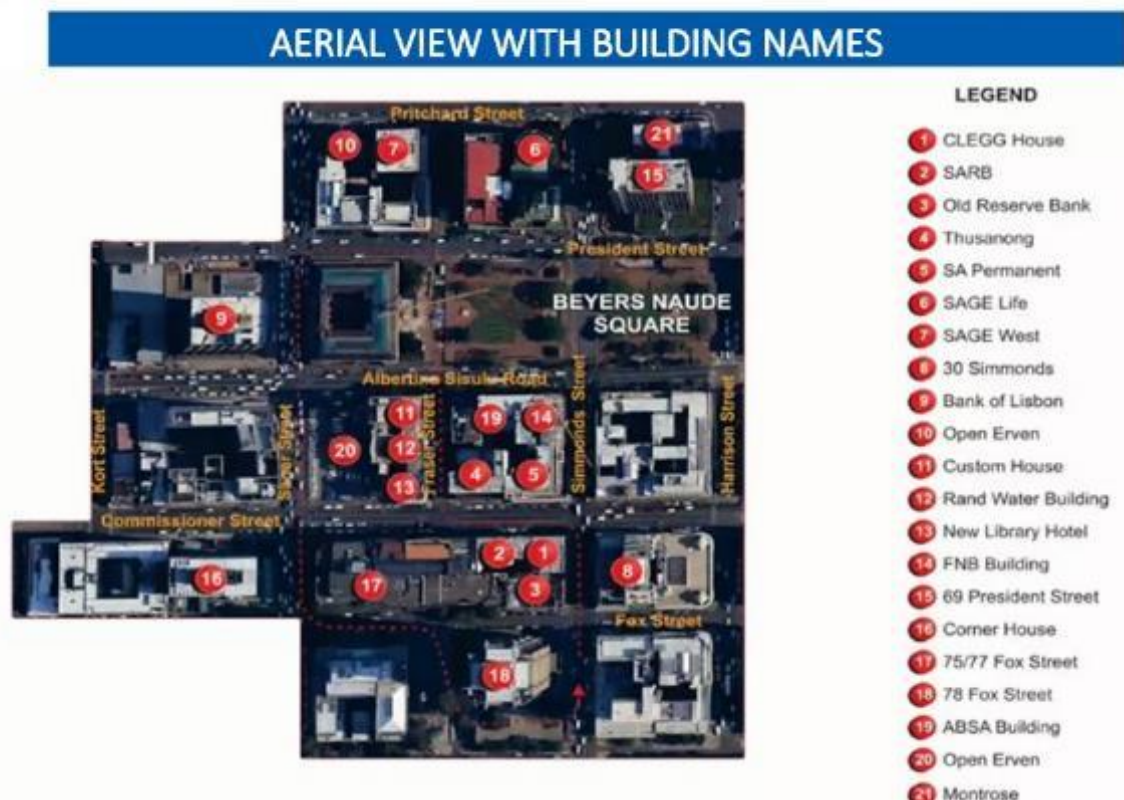


Figure 4. Aerial view with building names at the Kopanong precinct (Maxwell, 2016).

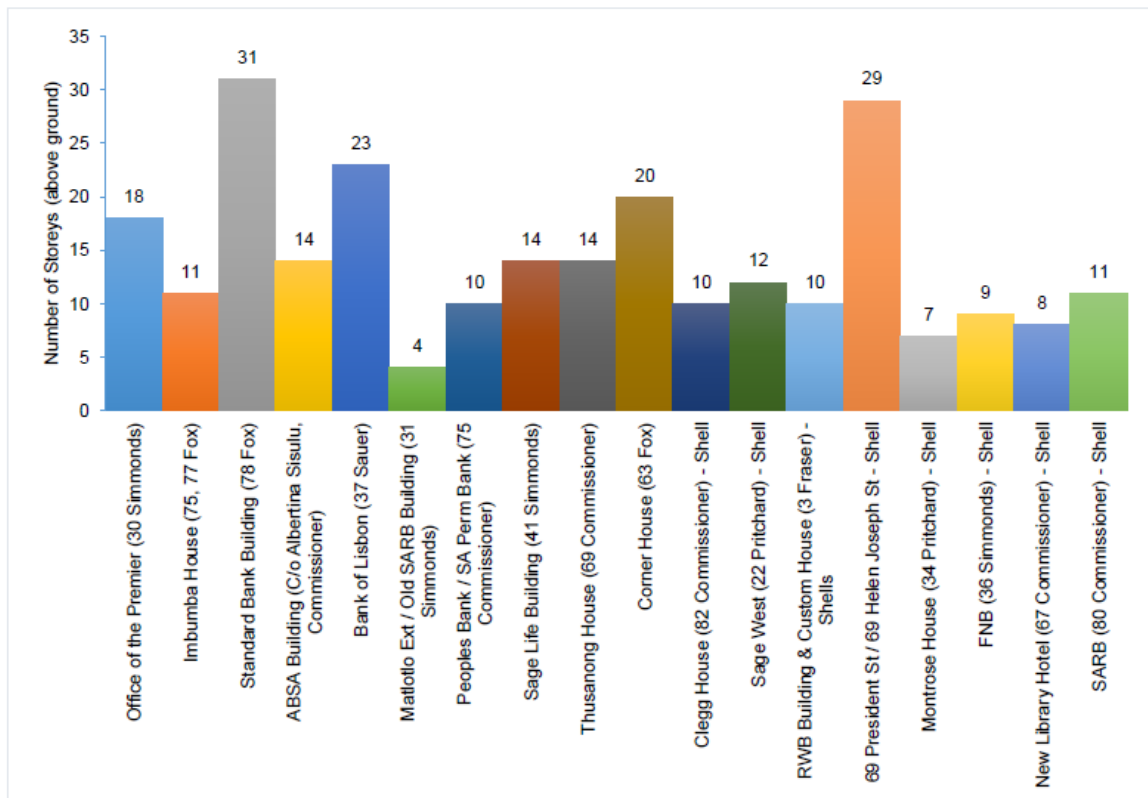


Figure 5. Vertical profile of precinct buildings

(GDID, 2015)

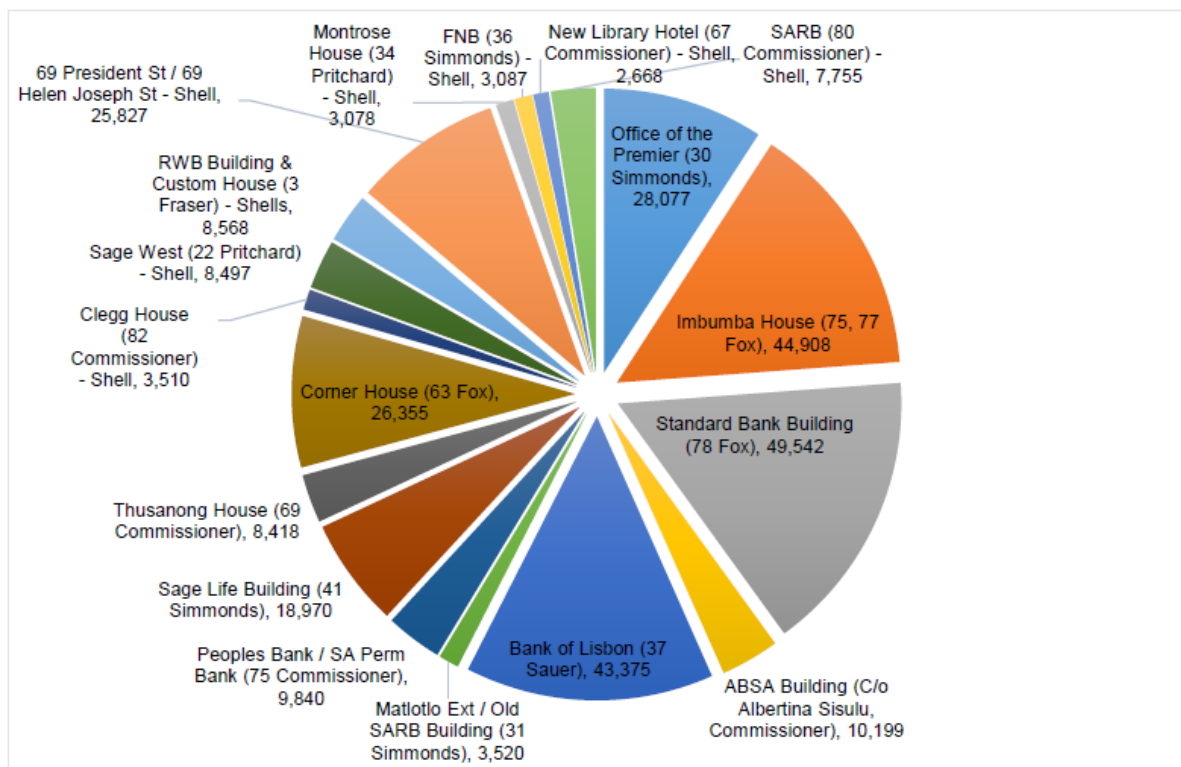


Figure 6. Constructed area of precinct buildings

(GDID, 2015)

6.1.4. Profile of the respondents

Respondent 6.1.1

The particular participant in this study is currently employed by GDID for the last two years and 11 months. He is the PPP project officer and is engaged by the province to deliver one of its game changer projects, the Kopanong Precinct Project in the Johannesburg central business district. The respondent's career spans decades and he also worked for many years at town planning in the United States of America.

Respondent 6.1.2

The particular participant is also employed by the GDID. He is Deputy Director for Lease Management at Gauteng Department of Infrastructure Development. He is an experienced administrator with a history of working in the government administration industry. Respondent 6.1.2 is a dedicated civil servant for more than a decade.

6.1.5. Semi-structured interviews

The interview with respondent 6.1.1 and 6.1.2 were conducted simultaneously on the 14 February 2018 at their offices in Rissik Street in Johannesburg CBD at 10:00. The meeting lasted approximately 90 minutes. Both respondents completed the consent forms and the meeting was recorded. This is available as appendix 1.

6.1.6. Provide your view on refurbishing existing buildings

All 19 buildings owned by the government and 2 vacant sites. These buildings would be completely refurbished on a full life cycle refresh basis, occupied or unoccupied over a period of 22 years. Occupancy in 2023 and on termination of the contract, everything would be given back to the city. Would be an additional 3.5 years' life cycle on whatever was there. This has evolved somewhat. Affordability issues, which are very clearly defined in treasury regulations. SARB building is now excluded from the PPP project as of 14 February 2018. Currently 18 buildings and 2 vacant sites (Respondent 6.1.1).

Respondent 6.1.2. Currently we are spending millions of rands leasing buildings. Refurbishment is not a key factor in leased building scenario. Kopanong precinct will reduce costs. All 14 departments will be accommodated in the precinct. Rentals escalate each year between 8 and 10%. The money can be channelled into maintained government buildings.

Respondent 6.1.1. asks the question, "If you don't do the PPP, what will you do?". He expresses his view strongly that this is the optimum solution to the challenge being faced.

Respondent 6.1.2. indicates that in instances where government departments lease a building, the landlord drives the refurbishment and costs are included in the rentals. *Of all the buildings that are leased, the department pays a portion for refurbishment and maintenance.*

6.1.7. In this context, describe the current state of the refurbishment process from a sustainable development perspective

- 6.1.7.1. *Environmental*
Energy, water, waste
- 6.1.7.2. *Economic*
- 6.1.7.3. *Social*

Respondent 6.1.2. indicates that in essence we are fixing the landlords building. *We have our own responsibilities like making sure the lights are working. The landlord is responsible for structural and façade aspects.*

The Corner House would be a good case study. It is situated on the corner of Commissioner and Sauer. Select floors are complete and some floors are still to be completed. Good opportunity to assess original and refurbishment.

6.1.8. Please describe the manner in which the brief is developed

6.1.8.1. Requirements, drivers, stakeholders

The brief is developed on various interpretations of full life cycle refresh on the 18 buildings. Would it be new furniture, an additional 3.5 years of life at the end of the process, will it meet full OSHA standards, what is the level of specifications, legacy assets like generator sets, security items. Cut corners on affordability and have “value for money impacts” and perhaps “deferred maintenance impacts” which can be assessed as costs that can be attributed but it is actually the cost of not spending money which you didn’t have, said the respondent 6.1.1.

Affordability is a key issue. The value for money is apparent but availability of funds is a challenge. Studies are being done by the transaction advisor currently to determine how much money can be cut out the buildings but still have people use the building as intended. We might come to a point when affordability is the key driver. We will see what decisions are made through the course of this week (14 – 21 February 2018). Respondent 6.1.1 is not aware of any intentions to reduce the scope of the project. A couple of owned buildings may be occupied or not may end up being another project or another category.

6.1.9. What are the key areas for improvement (building) noted in the refurbishment process/strategy?

Respondent 6.1.1. indicates that the key area for improvement is functional availability equating to Service Level Agreements (SLAs). *Room data sheet including lighting, heating, furniture, finishing’s. All spaces should be functionally available. Partially functionally*

available when lighting or usability is compromised. A penalty would be charged against the private party. They (private party) would realise that the cost of buying a proper chair for example would be cheaper than paying these penalties. The standard is much higher generally in a PPP. This standard is enforced through penalties. Private party selects the furniture and finishing's but they must meet the functional requirement. There is the issue of reduction in the standard of functional availability. Example of a chair with lifecycle of 1-year vs that of a chair with a life cycle of 10 years.

One of the goals of this project is to consolidate government head office into a precinct, a tightly confined area and efficiently serviced zone. A common access for the people we provide facilities and services to. Select employees can spend up to 50% of their disposable income on taxis and other means of transportation. Respondent 6.1.2 agrees on the shared benefits of central services. A customer may be looking for human settlements for example and they are misunderstood and think its infrastructure and then realise that it may be on the other side of town. This is the socio economic aspects will be addressed through the project.

There are also the actual costs saving gained from doing things more efficiently. Increased efficiencies of approximately 5%. Rigorous productivity analysis. Remuneration budget of all 14 departments over the 22-year period. Extrapolated costs going forward.

6.1.10. Generally, in this context are you able to meet the requirements of the brief?

Respondent 6.1.1. answers that the department will be in the bottom range of meeting the original brief. The intention was to be higher up on the scoring range. "We won't and cannot betray the brief but we are going to have to go in at the bottom range" says Respondent 6.1.1.

"Are we going to be able to meet the standards we were hoping for?" asks Respondent 6.1.1., this is being relooked at in great detail.

6.1.11. What are the noted improvements in building performance?

Respondent 6.1.1. The overall performance would be how many GLA meter do we use. Divide the GLA number by the number of people in it. 3 years ago it was approximately 18 square meters per person. In some places you could get this figure down to 12 square meters per person. This building (18 Rissik) is not in the precinct and it is also not owned by the department but rather it is leased. The Initial bid was for 14 square meters per person GLA. It might be that the target for the bidders is 15 square meters per person although this is reduced it is still 30% less than the department had. Spatial efficiencies and relationship with the original brief. Internal team also "bid" and then go to the market and present the opportunity.

6.1.12. Comment: integration of social, economic and environmental factors into planning, implementation and decision-making

Respondent 6.1.2 has responded to this above. He mentions the opportunity for shared central services and the benefits and efficiencies gained.

Respondent 6.1.1. says that the department has to meet OSHA requirements a minimum. *Some buildings are more challenging than others due to age and building types. We have to have carpet and paint but the specification may be reduced slightly. The original notion was to target Green Star South Africa 4 or 5 Star. Currently no firm commitment for GSSA 4-star rating.*

Respondent 6.1.2. mentions that that the department has other owned buildings that exists outside of the Kopanong Precinct. *"We have other commercial buildings which we lease out."* Respondent 6.1.2. *Buildings which were acquired by other user departments for other purposes which there might not be a need for that now. These are leased out and these include student accommodation for instance.*

Respondent 6.1.1. Each PPP professional team require office space from which to work. *SARB (South Africa Reserve Bank) building may host these functions. Private party can refurbish the space and occupy together with government team. Saving the private parties money which they would otherwise spend. Futuristic thinking and forward planning anticipating change and expansion possibilities.*

Environmental factors, all those considered in GSSA categories. We have the best practise standard and now we will assess what is possible for us to achieve.

6.1.13. Comment: energy assessment and classification, identification of technological solutions for energy efficiency and the integration of renewal systems

Respondent 6.1.1. discusses the roof top gardening concept. *The current premier is convinced of the multiple associated benefits. This is not officially in the project scope. Not a line item in the RFP. Also another program is roof top solar and this is still a key target. This was in the original mandate. Roof top solar is specific and the building contractor must provide a proposal for accommodating this solution. There is currently no output specification. Formerly adopted priorities and goals.*

6.1.14. Addressing the research objectives

6.1.14.1. Analyse the current building stock vis-a-vis the main tenets of green building performance in the public sector.

Currently, a significant amount of money is spent leasing buildings. Refurbishment is not a key factor in a leased building scenario. The Gauteng department does indirectly fund refurbishments as they do occur through their rental costs although the refurbishment process and decisions are largely driven by the landlord. Leased buildings do not present an appealing opportunity for improved building performance. *"Currently we are spending millions of rands leasing buildings. Refurbishment is not a key factor in leased building scenario. Kopanong precinct will reduce costs. All 14 departments will be accommodated in the precinct. Rentals escalate each year between 8 and 10%. The money can be channelled into maintained government buildings"*. Respondent 6.1.2.

6.1.14.2. Collate the relevant policies and frameworks associated with the sustainable refurbishment of existing buildings in South Africa.

A key consideration mentioned at this case study was occupational health and safety standards being complied with. In this instance the original intention was to target Green Star South Africa (GSSA) minimum 4 Star for all buildings in the Kopanong Precinct. *“The original notion was to target Green Star South Africa 4 or 5 Star. Currently no firm commitment for GSSA 4-star rating”*. Respondent 6.1.1.

6.1.14.3. Identify the policy objectives of green building in South Africa.

A clear focus on people has emerged through this case study. The ability to significantly reduce transportation costs was a targeted outcome. Shared amenities and buildings within close proximity to each other and public facilities will deliver long term benefits when considered against remuneration and productivity. *“One of the goals of this project is to consolidate government head office into a precinct, a tightly confined area and efficiently serviced zone. A common access for the people we provide facilities and services to. Select employees can spend up to 50% of their disposable income on taxis and other means of transportation”*. Respondent 6.1.1. Reduction in the use of energy was also noted through the implementation of rooftop solar strategies.

6.1.14.4. Analyse local implementation strategies.

The Kopanong Precinct Project delivered through a Public Private Partnership can be viewed as a strategy to achieve the departments vision of sustainable development and construction. *“If you don’t do the PPP, what will you do?”*. Respondent 6.1.1. On a smaller scale the roof top garden and roof top solar interventions are delivering positive results from a social, environmental and economic perspective.

6.1.14.5. Assess the success factors in the implementation of the different solutions and technologies.

“One of the goals of this project is to consolidate government head office into a precinct, a tightly confined area and efficiently serviced zone. A common access for the people we provide facilities and services to”. Respondent 6.1.1. The Public Private Partnership model aims to deliver positively on multiple aspects including; space optimization, improved interdepartmental efficiencies, improved building performance through reductions in water, energy and waste, improved well-being and productivity of government employees and uplifting of the urban landscape of the city.

6.1.15. Summary

Environmental, economic and social concerns and solutions were clearly articulated during this interview. Affordability and optimising government departments spend where concerns are raised. The respondent 6.1.1. felt very strongly the PPP model is the optimum and feasible model for implementation. *In leased buildings the department is funding the refurbishment through their rentals per month. In these type instances the landlord is driving the refurbishment and maintenance projects with little or no inputs from the tenants.* Respondent 6.1.2 indicates that currently millions of rands are spent leasing other buildings (not owned by the government). *This results in the government paying for fixing of the landlord's buildings.*

Life cycle analysis and life cycle costings are raised at the earliest stages of the project and this is encouraging. Affordability is an issue that is being raised now but the scope of the project has not been reduced. This is also one of the major projects of this type and scale which effectively demonstrates the improvements that it will bring to the precinct, the environment, the department and the building occupants.

A highlight of the discussion was the reference to improved productivity of building occupants and the effects this would have on results and productivity. Well-being and the relationship with buildings is trending currently as highlighted in the literature review and review of policies and frameworks. Creating areas for social interaction and making available the required amenities through the precinct developments also has the benefit of reduced transportation costs, therefore an increase in disposable income for the building occupants and department employees.

The respondents indicate that the brief will be met and this too is positive for this case study and model. A noted and expected improvement is that of spatial efficiencies. Both respondents indicate that using space more effectively has positive impacts on social, environmental and economic facets. The department is targeting between 12 and 13 square meters per person GLA.

Another positive note that emerged from the discussion was that of the aspiration toward Green Star certification. The intention is to consider all buildings within the precinct project to be compliant with the requirements for Green Star South Africa minimum 4 Star rating. The respondents indicate that many green building initiatives are already intended for implementation and an assessment of the certification requirements could demonstrate that certification is considerably within reach. The rooftop solar green building technology is intended for widespread or total implementation across all buildings. The internal design team is aiming for 50% energy generation of the building requirements. The rooftop garden concept also has multiple benefits including supporting occupant well-being and social interactions and development.

6.2. Case Study 2: The Corner House

6.2.1. Introduction

Known as The Corner House, this case study is located at 63 Fox Street in the Johannesburg CBD.

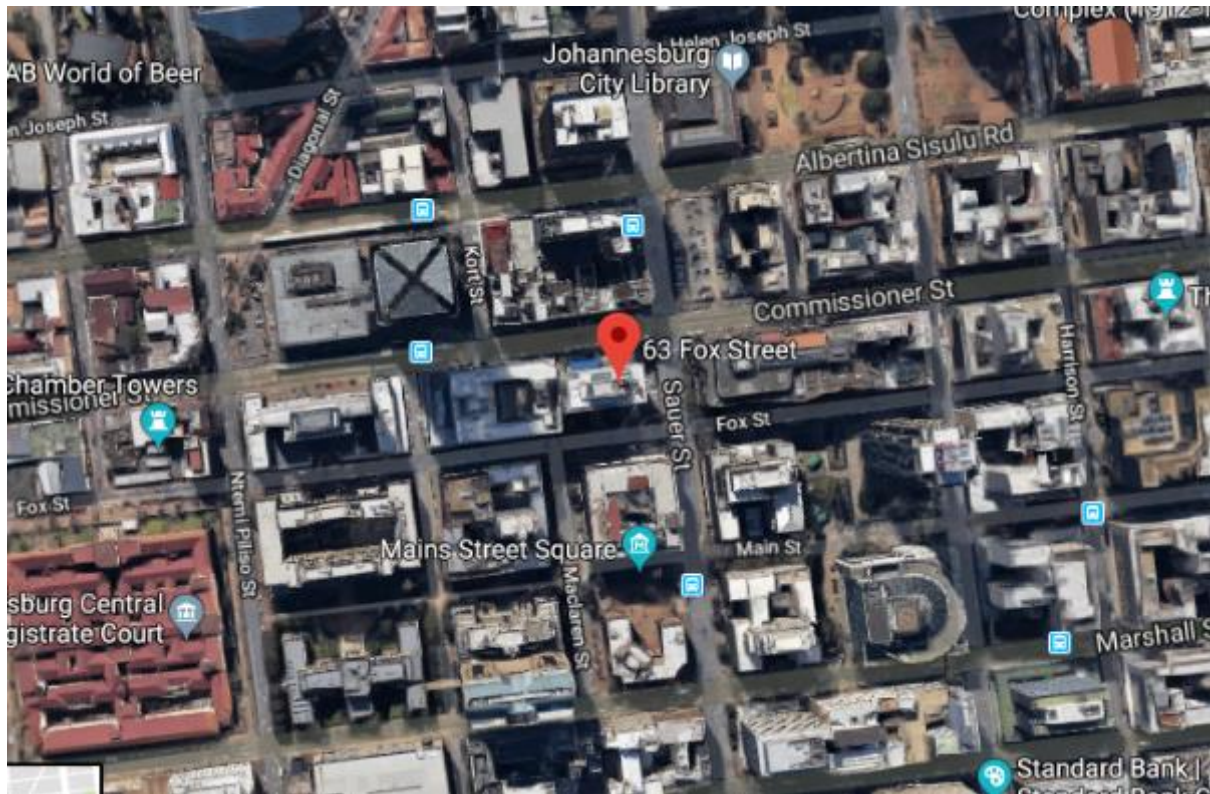


Figure 7. 63 Fox Street. Google map view

(Google Maps, 2018)



Figure 8. View toward The Corner House from Pixley Ka Isaka Seme Street looking north (Google Maps, 2018).

The building, owned by the government, was built in 1965 and has a GBA and GLA of 28 566 m² and 16 393 m² respectively. The building is now accommodating administrative head office functions.

6.2.2. Project description

The timeline for the project was five months and was delivered timeously. The affected employees were “decanted” into another available building at 11 Diagonal Street (a leased building) for the duration of the project. The refurbishment costs were approximately R2 million per typical floor and the unique ground floor costing approximately R13 million as indicated by respondent 6.2.1.

6.2.3. Project scope

The scope included the ground floor refurbishment and floors 13 to 16 also requiring a refurbishment to accommodate the 400 department employees. These included GDID employees and COGTA (Department of Co-operative Governance and Traditional Affairs). A complete new installation of HVAC and electrical including light fittings as well as new drywalls and ceilings systems was included in the refurbishment. Unfortunately, the external envelope including the existing façade and glazing was not improved upon due to budget constraints.

6.2.4. Profile of the respondents

Respondent 6.2.1

This respondent is currently director at project management for buildings other than health and education sectors. He joined the GDID in 2012. Currently focused on refurbishment projects and he will receive the brief from the various departments and establish the brief and manage the entire project from design through to occupancy. The projects are primarily located in the Johannesburg city centre.

6.2.5. Semi-structured interviews

The interview with respondent 6.2.1 was conducted on the 26 February 2018 at his office in Rissik Street in Johannesburg CBD at 09:20. The meeting lasted approximately 100 minutes. The respondent completed the consent forms and the meeting was recorded. This is available as appendix 1.

6.2.6. Provide your view on refurbishing of existing buildings.

Reference is made to GIAMA (Government Immovable Asset Management Act) and leads to definitions of restoring and refurbishment. The respondent described minor improvements from paint to major refurbishment that could include changing the look of the building. *The refurbishment of buildings is also revisited periodically between 5 and 10 years.*

However, government finance challenges make it difficult to effect refurbishment periodically as intended. Refurbishment projects usually develop based on user or occupant dissatisfaction or due to compliance concerns.

6.2.7. In this context, describe the current state of the refurbishment process from a sustainable development perspective.

6.2.7.1. Environmental

Energy, water, waste

6.2.7.2. Economic

6.2.7.3. Social

The respondent describes that as government recognises and believes in the green building initiatives and aspects that will result in better sustainability of government buildings. *The GDID is serious about this and has a green building directorate. The respondent's team has worked closely with the green building directorate to establish the existing state and look at solutions to improve the performance through green initiatives.* The respondent indicates that they ensure that when mechanical systems are being replaced that they are replaced with energy efficient systems and this is the same for water fittings. *Special attention is paid to source water efficient fitting where possible especially regarding low flush and dual flush wc's. Corner House project is one of the projects that implemented monitoring systems which the green building directorate will elaborate on. At Corner House both water and electrical monitoring systems were installed to measure if the objectives have been achieved. Even the separation of waste was considered at The Corner House but was not possible to implement at the project. It is much easier to implement waste separation and bio digesters at schools*

and hospitals when compared to office buildings. Schools and hospitals are also making great progress regarding the implementation of water and energy monitoring systems.

In the city centre the precinct project (Kopanong Precinct Project) takes precedent over other (isolated) refurbishment projects. The optimum ratio of sustainability measures will be implemented at the precinct project. Environmental and social impacts have been carefully considered at the precinct project.

Regarding social impacts at The Corner House; these were limited to brand awareness and employee security at the ground floor. Resting and waiting areas as well as information stations were attempted at Corner House although these will be intensified at the precinct project (Kopanong Precinct Project).

6.2.8. Please describe the manner in which the brief is developed

6.2.8.1. Requirements, drivers, stakeholders

The respondent indicates that the brief is developed in most instances through expansion and department requirements that could be changing as well as compliance concerns. *In instances the occupants express their dissatisfaction in the spaces from a planning and comfort perspective.*

The respondent is primarily responsible for developing the brief. *GDID is the implementing agent for all departments in the Gauteng province.* The respondent previously worked at the division responsible for schools and there is also a division dedicated to hospitals and clinics. The property management department also deals with leasing.

6.2.9. What are the key areas for improvement (building) noted in the refurbishment process/strategy?

Definitely in the city centre the priority is office space. Maximising office space through space planning and open plan work space configurations to comply with current office norms and standards documents. Respondent indicates that GDID is public works but a regional division of public works.

Compliance in terms of full OHS implementation as well as fire requirements. City centre parking is always a major challenge. Public transport was perceived as better in past years. Currently public transport infrastructure is proving to be inadequate.

Waste control is also key consideration. Currently there is also a rooftop solar project. The Corner House project has benefitted from this. The target is 30% energy obtained from the rooftop solar intervention.

6.2.10. Generally, in this context are you able to meet the requirements of the brief?

The respondent indicates that generally the requirements of the brief are met. Certainly space requirements must be met as well as OHS (Occupational Health and Safety) compliance. *There*

is generally a lack of understanding regarding waste separation and recycling initiatives and the impacts associated. Regarding solar energy interventions, at this stage The Corner House is one of a few examples but at the precinct (Kopanong) this will be a significant and widespread intervention.

School and other education facility projects are making good progress regarding solar intervention implementations. This is a minimum requirement of 30% energy supply.

Energy efficiency was somewhat compromised as the external façade was unfortunately not addressed due to project constraints. Select sections of glazing was not in ideal conditions. As per the departments guidelines this project did qualify for a full refurbishment including the external façade but this was not possible.

6.2.11. What are the noted improvements in building performance?

User satisfaction and spatial allocation were noted improvements.

6.2.12. Comment: integration of social, economic and environmental factors into planning, implementation and decision-making

6.2.13. Comment: energy assessment and classification, identification of technological solutions for energy efficiency and the integration of renewal systems

Green technologies are being monitored at The Corner House project. Smart meters were installed for both energy and water consumption.

6.2.14. Addressing the research objectives

- 6.2.14.1. Analyse the current building stock vis-a-vis the main tenets of green building performance in the public sector.

This case study revealed the presence of a wide range of refurbishment options ranging from repainting wall surfaces to significantly altering the building aesthetic and function. Typically, refurbishment projects are cyclic and occur between 5 and 10 years but finance challenges often interrupt these intended projects. *“Government finance challenges make it difficult to effect refurbishment periodically as intended. Refurbishment projects usually develop based on user or occupant dissatisfaction or due to compliance concerns”*. Respondent 6.2.1.

- 6.2.14.2. Collate the relevant policies and frameworks associated with the sustainable refurbishment of existing buildings in South Africa.

Reference is made to GIAMA (Government Immovable Asset Management Act) during these discussions. OHS and fire regulations often prompt refurbishment and at the same time address vital social concerns related to well-being, safety and productivity. City planning, parking availability and public transport infrastructure into and out of the city centre is highlighted as drivers in the decision making process where refurbishing of existing buildings are concerned.

6.2.14.3. Identify the policy objectives of green building in South Africa.

Government recognises and believes in the green building initiatives and aspects that will result in better sustainability of government buildings. The GDID has demonstrated its commitment to the drive toward sustainability through the formation of a green building directorate a few years ago. *“The GDID is serious about this and has a green building directorate. My team has worked closely with the green building directorate to establish the existing state and look at solutions to improve the performance through green initiatives”*. Respondent 6.2.1. Further objectives of the frameworks and guidelines highlighted in this case study included; maximising office space through space planning and open plan work space configurations to comply with current office norms and standards documents. Attractive city centre office space is aimed for.

6.2.14.4. Analyse local implementation strategies.

Strategies include targeting reductions in energy and water consumption in existing buildings. Existing inefficient mechanical systems are being replaced with more energy efficient systems. The same concept is applied to water fittings and fixtures. *“Special attention is paid to source water efficient fitting where possible especially regarding low flush and dual flush wc’s. Corner House project is one of the projects that implemented monitoring systems”*. Respondent 6.2.1.

Optimized space planning and occupant comfort were key considerations. Social interventions were also intensified on the ground floor and these included aspects of; security, transition areas, pause and collaboration areas as well as branding and awareness.

6.2.14.5. Assess the success factors in the implementation of the different solutions and technologies.

This case study had both energy and water monitoring systems installed to measure and verify consumption against targets. *“At Corner House both water and electrical monitoring systems were installed to measure if the objectives have been achieved. Even the separation of waste was considered at The Corner House but was not possible to implement at the project”*. Respondent 6.2.1. *“Green technologies are being monitored at The Corner House project. Smart meters were installed for both energy and water consumption”*. Respondent 6.2.1. The rooftop solar project was implemented at this case study and is a reference for other existing buildings planned for refurbishment in the near future. The target is 30% of the buildings energy requirement is gained through this intervention.

User satisfaction and spatial allocation were notable improvements.

6.2.15. Summary

Early in the discussion the concept of occupant well-being is introduced as a driver for refurbishment through user dissatisfaction. Users of buildings are unhappy with the environment they are confined to and this negatively affects their well-being. Safety and compliance was also a priority after people needs.

This respondent who is director at his department conveys the government's commitment to sustainable development and using green buildings, green building technologies and initiatives as a means to achieving sustainable development. Further, the recently configured green building directorate reinforces government's commitment to sustainable development. Wherever possible, mechanical systems are replaced with energy efficient systems. The same principle applies for replacing of water fittings with efficient solutions. Energy and water meters are installed and monitored.

Throughout the discussion a consistent message was that waste separation and subsequent diversion of waste from landfill is not proceeding at a rate that was expected at office buildings. Waste control has been identified as a key consideration. Feedback received is that there may be a general lack of understanding regarding waste separation and recycling initiatives and the associated impacts. Waste separation is more successful at schools due to focus, priority with stakeholders and also willingness from those involved.

Education and healthcare sectors are a priority for GDID and this emerged on a few occasions during the discussion. Energy and water reductions through green technologies and solutions are also relatively more successful at education and healthcare projects.

Roof top solar was implemented at Corner House project. The target is for 30% of building requirement to be delivered via the rooftop solar intervention. Environmental and social issues have been carefully considered for the Kopanong Precinct Project. Social impacts were considered at the Corner House project through resting and waiting or interacting areas but the respondent indicates that this will be significantly intensified at the Kopanong precinct project.

Directly related to user satisfaction is spatial planning and allocation. Optimising office space is seen as a key focus area. Improvements in spatial allocation and planning are identified as a noted improvement during the refurbishment process.

Unfortunately, at this case study the external existing fabric of the building was not addressed.

6.3. Case Study 3: Pritchard Street

6.3.1. Introduction

This case study is a leased building situated at the corner of Pritchard and Joubert street. It is currently the new location for the Department of Safety and a five-year lease agreement was signed. The Department of Safety is the sole tenant at the building.

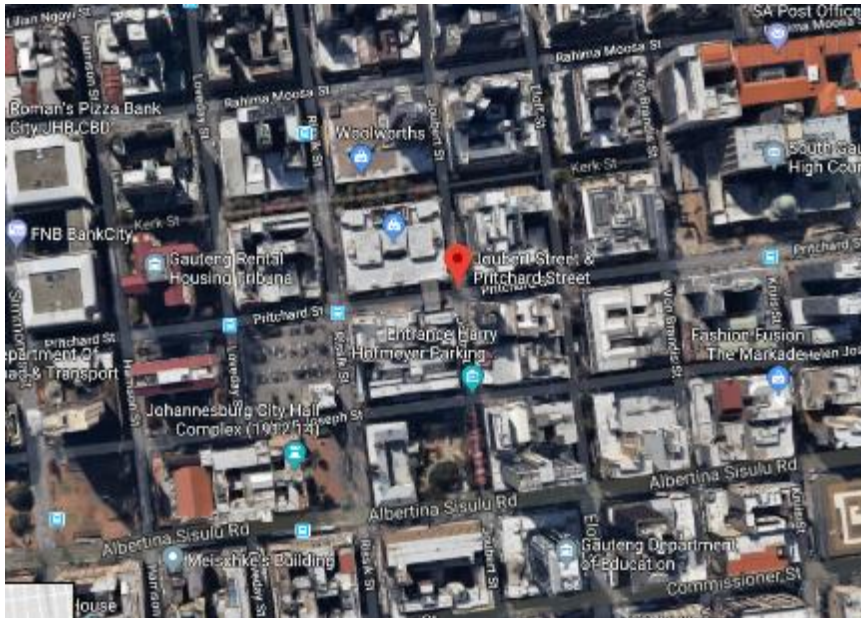


Figure 9. Corner of Pritchard and Joubert Streets. Google map view (Google Maps, 2018)



Figure 10. Corner of Pritchard and Joubert Streets. Looking South West.

(Google Maps, 2018)

6.3.2. Project description

The Department of Safety was housed in an owned building, 78 Fox Street which is a historic landmark project. The intention originally was to move all employees out of 78 Fox Street due to a major refurbishment project at 78 Fox Street. 78 Fox Street is one of the buildings included in the Kopanong precinct project.



Figure 11. 78 Fox Street.

(Johannesburg Heritage Foundation, 2017)



Figure 12. Corner of Helen Joseph and Joubert Streets. Looking North West

(Google Maps, 2018)

6.3.3. Project scope

Respondent was responsible for an audit of existing staff compliment and functional requirements. Using space norms, the average area per person was established. Examples; admin staff 6-8m², senior staff approximately 10 m², assistant directors 12 m², deputy directors 16 m², director 20 m², chief director 20-25 m², executive from 25 m² above like Member of the Executive Council (MEC) and Deputy Director-General (DDG). Space norms

and standards for government buildings provide guidance on the special requirements. The refurbishment extended through seven floors of the building.

The refurbishment project was originally intended to be completed in four months but this was extended to six months.

6.3.4. Profile of the respondent

Respondent 6.2.1

This respondent is currently director at project management for buildings other than health and education sectors. He joined the GDID in 2012. Currently focused on refurbishment projects - he receives the brief from the various departments and establishes the brief and manages the entire project from design through to occupancy. The projects are primarily located in the Johannesburg city centre.

6.3.5. Semi-structured interviews

The interview with respondent 6.2.1 was conducted on 26 February 2018 at his office in Rissik Street in Johannesburg CBD at 09:20. The meeting lasted approximately 100 minutes. The respondent completed the consent forms and the meeting was recorded. This is available as appendix 1.

6.3.6. Provide your view on refurbishing of existing buildings.

Reference is made to GIAMA (Government Immovable Asset Management Act) and leads to definitions of restoring and refurbishment. The respondent described minor improvements from paint to major refurbishment that could include changing the look of the building. *The refurbishment of buildings is also revisited periodically between 5 and 10 years.*

However, government finance challenges make it difficult to effect refurbishment periodically as intended. Refurbishment projects usually develop based on user or occupant dissatisfaction or due to compliance concerns.

6.3.7. In this context, describe the current state of the refurbishment process from a sustainable development perspective.

6.3.7.1. Environmental

Energy, water, waste

6.3.7.2. Economic

6.3.7.3. Social

Due the building being a leased in building, environmental initiatives were difficult to implement as the landlord is responsible for these. Exceptionally economical space planning solutions were required and implemented. New mechanical ventilation systems were installed. The respondent indicates that energy efficient systems were installed. The existing building was stripped down to the structure. New electrical installations and energy efficient lighting systems and solutions were implemented.

6.3.8. Please describe the manner in which the brief is developed

6.3.8.1. Requirements, drivers, stakeholders

The respondent indicates that one of the drivers of the project was actually to empty out 78 Fox Street. The respondent is primarily responsible for developing the brief.

6.3.9. What are the key areas for improvement (building) noted in the refurbishment process/strategy?

The existing building was an empty and dilapidated building. Everything needed to be replaced and made good. New plumbing, sanitary fixtures and fittings were all water efficient solutions but these were at the cost of the landlord. The electrical and mechanical installations were also at the cost of the landlord. The landlord was required to ensure the building is habitable.

No work was done to improve the performance of the external façade. Broken and damaged windows and frames were replaced with same specification. The notable visual improvement was painting of the external façade resembling our South African flag as per the image above.

6.3.10. Generally, in this context are you able to meet the requirements of the brief?

Yes, the brief was met from the respondent's perspective. There were select contractor installation challenges regarding mechanical ventilation functionality and some flooding in the basement but these were eventually attended to.

6.3.11. What are the noted improvements in building performance?

It was existing as an empty dilapidated building therefore; the benchmark is extremely low. It is now a comfortable and fully functioning building. Feedback from occupants on their experiences is positive.

6.3.12. Comment: integration of social, economic and environmental factors into planning, implementation and decision-making

6.3.13. Comment: energy assessment and classification, identification of technological solutions for energy efficiency and the integration of renewal systems

No monitoring systems or significant technological solutions are implemented in buildings that are not owned by government.

6.3.14. Addressing the research objectives

6.3.14.1. Analyse the current building stock vis-a-vis the main tenets of green building performance in the public sector.

As per Corner House case study above. There is a presence of a wide range of refurbishment options ranging from repainting wall surfaces to significantly altering the building aesthetic and function. Typically, refurbishment projects are cyclic and occur between 5 and 10 years but finance challenges often interrupt these intended projects. Occupant dissatisfaction and

concerns regarding building compliance are more often the key drivers for refurbishment projects. *“It was existing as an empty dilapidated building therefore; the benchmark is extremely low. It is now a comfortable and fully functioning building. Feedback from occupants on their experiences is positive”*. Respondent 6.2.1.

6.3.14.2. Collate the relevant policies and frameworks associated with the sustainable refurbishment of existing buildings in South Africa.

Besides legislative requirements including safety and fire, there was no direct link to any sustainable development guidelines or framework. This case study was an instance that included a building not owned by government and generally the decision making was held by the landlord. *“No monitoring systems or significant technological solutions are implemented in buildings that are not owned by government”*. Respondent 6.2.1.

6.3.14.3. Identify the policy objectives of green building in South Africa.

Typical objectives like energy and water reductions were possible to address at this case study only because the building was dilapidated and unoccupied and the landlord and contractor were amenable to suggestions regarding efficient systems. *“New plumbing, sanitary fixtures and fittings were all water efficient solutions but these were at the cost of the landlord”*. Respondent 6.2.1.

6.3.14.4. Analyse local implementation strategies.

These included and energy efficient HVAC systems as well as water efficient fittings. No monitoring systems or significant technological solutions are implemented in buildings that are not owned by government. The performance of the external façade was left predominantly in its original condition expect for the replacement of a few broken windows. *“No work was done to improve the performance of the external façade. Broken and damaged windows and frames were replaced with same specification. The notable visual improvement was painting of the external façade resembling our South African flag”*. Respondent 6.2.1.

6.3.14.5. Assess the success factors in the implementation of the different solutions and technologies.

Feedback from occupants on their experiences in the refurbished building is positive regarding spatial allocation and user comfort. *“It is now a comfortable and fully functioning building”*. Respondent 6.2.1.

6.3.15. Summary

It is apparent that sustainably refurbishing of leased buildings are more difficult to effect when compared to buildings that are owned by government. This is as a result of the landlord being responsible for the costs and decisions related to refurbishment items at projects. Here, as well as at the Corner House case study, occupant dissatisfaction was a driver for refurbishment.

The Pritchard Street case study was unique as the existing building prior to being occupied by the government, was a dilapidated and unoccupied building. This meant that all new mechanical and electrical systems had to be fitted. The department had an opportunity here to influence solutions selected and this resulted in energy efficient mechanical and electrical systems being installed. New plumbing and water efficient fittings and fixtures were also installed. The installation of energy and water efficient solutions may not have been possible in a typical leased out building where these installations would exist and be in working order.

At Pritchard Street too, like the Corner House case study, efficient space planning was a key focus area.

Unfortunately, at Pritchard Street, like the Corner House case study, the existing external fabric was not improved upon. This is a lease out building owned by an independent landlord, therefore it was not in the interest of the government to invest in improving the performance of the existing external façade. A missed opportunity here is that existing poor performing glazing was replaced with same where required, due to broken or cracked panes of glass. Select facades or portions of facades could have been highlighted for replacing with improved thermal and acoustic glazing. No energy and water monitoring systems were installed as these are not encouraged in buildings that are not owned by government.

Noted improvements for this case study were challenging to identify due to the nature of the building prior to occupation being unoccupied and dilapidated. Positive feedback from users were generally based on a comfortable working environment.

6.4. Interview with Chief Architect & Case Study 4 – 6 Hollard Street & Kopanong Precinct

6.4.1. Introduction

Two cases were addressed during this interview. The respondent elected to discuss the positives and negatives in each of the instances.

6.4.2. Project description

The one case addresses a leased-in building situated at 6 Hollard Street and accommodates the Department of Education. The building extent is 23 614m² rentable area over ground plus ten floors.

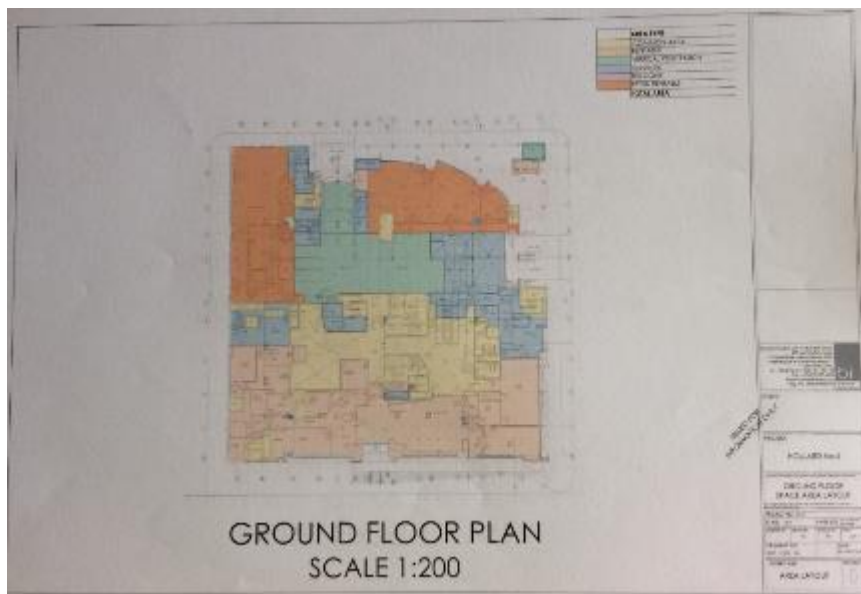


Figure 13. 6 Hollard Ground floor plan

The second case discussed is that of the Kopanong precinct which is also discussed earlier in this chapter. This is a project including the refurbishment of 18 government owned buildings in the Johannesburg CBD.

6.4.3. Project scope

Kopanong Precinct: The need to provide government employees a place to work and that's what the precinct is about. We own the buildings and lease it to ourselves.

Kopanong precinct is an example of a government precinct approach with the main aim of achieving administrative efficiency through collaboration and spatial relationships. The precinct will allow community members to access multiple government offices and services in one area.

The Kopanong precinct project will provide the city of Johannesburg with a great opportunity to contribute to the revitalisation of the city centre. Redeveloping the existing buildings and

streetscapes will allow for a transformation of the public realm. The project will require significant capital estimated at several billion rands (GDID, 2015).

Green building principles will form part of the design brief ensuring that water and energy conservation are prioritised as well as occupant comfort and safety.

6 Hollard: This is a leased in building. The Department of Education needed to rent space. A lease agreement was signed. This building is situated opposite 78 Fox Street. Approximately 3-4 months' installation time and the department moved in at the beginning of 2017.

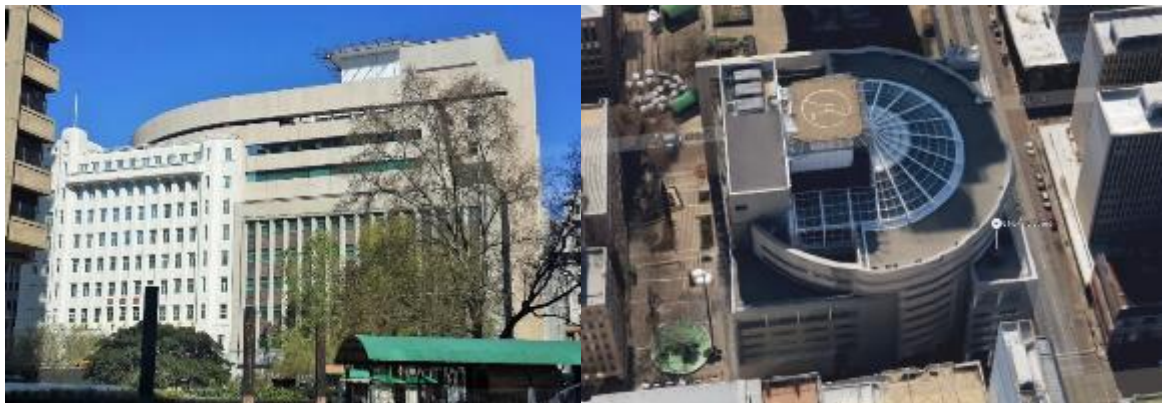


Figure 14. 6 Hollard Street. Street view and Aerial View

(The Heritage Portal, 2017)

6.4.4. Profile of the respondents

Respondent 6.4.1

The chief architect in GDID with one of many responsibilities being space planning, specifically dealing with lease in projects which are third party lease in projects. The respondent explains that a building is a machine and describes how buildings work. In 2009, the idea was to buy buildings rather than spend money on leased in buildings.

6.4.5. Semi-structured interviews

The interview was conducted on the 26 February at 11:00 in office in Rissik Street, Johannesburg. The interview lasted 3.5 hours. The respondent completed the consent forms and the meeting was recorded. This is available as appendix 1.

6.4.6. Provide your view on refurbishing of existing buildings.

The respondent spends some time discussing the meaning of sustainability in this study. *A person equals function equals space that they require. Social aspects of the building to be considered; transport to and from work/home, rest areas, parking areas eating areas. Reference to chief architect in Washington and the drive to use public and office space more efficiently.*

The respondents view is that refurbishing of existing buildings is the most sustainable response when considered against other activities in the built environment.

6.4.7. In this context, describe the current state of the refurbishment process from a sustainable development perspective.

6.4.7.1. Environmental

Energy, water, waste

6.4.7.2. Economic

6.4.7.3. Social

The intention is to increase the longevity of products and systems installed in a building. Consider whole life cycle costs. Also consider the impacts of products and systems across its entire lifecycle. Select stages of its lifecycle may have significantly greater impacts on the environment than other stages in the life cycle if the product.

The need of our society far outweighs our available financial and human resources. Currently the greatest need and therefore the focus is on education and healthcare facilities and take care of the poor and not necessarily provide optimum office space for government employees. It is not a simple question of “why don’t we rent our own space?”, “why don’t we just fix our own buildings?”. The respondent explains that the building is not just how you use it but it is also about how the building uses itself.

Empty buildings have the greatest risk of rapidly reaching their end of life. This is a generally accepted concept by owners, occupants and landlords.

The respondent spends some time discussing the meaning of sustainability in this study. It may mean to remove and reuse elsewhere. The example of wheelbarrows to chairs is described.

The Kopanong Precinct project aims to invite investors to complete the project and then lease them to the state for a period of time.

It might be cheaper if we lease our building. Now, every five years we spread the load and consequently we fix the buildings. DID is a custodian who deals with office space. If the lease expires then we take the departments HR structure and checks against requirements. A calculation is done and space provided for accordingly. Then cyclically, 3, 5, 9, years the opportunity for employment is spread and this supports job creation. Historically a building like 78 Fox Street where a little bit of space is being used and this building is not in a good condition as per the conditional assessment, it is difficult to justify the investment when the priority is hospitals and schools. It is easier to engage a landlord and pay a market related price to lease in a building and don’t have to concern with maintaining the building including ensuring the lifts are working. All that is required is to maintain the light fittings and change a bulb when required. The Kopanong precinct project detracts significantly from this model.

At the moment the precinct buildings whose conditions have been assessed are awaiting investor confirmations.

Building assessment conditions

Physical assessments of the Kopanong Precinct buildings were carried out in 2015. The results are graphically represented in the figures below. The condition standard of the various building elements is compared to the actual condition of each of the buildings construction elements. Building elements include; roofs, external walls, external finishes, external windows, external doors, internal walls, internal finishes, internal doors, internal floors, internal finishes, internal ceilings, internal fixtures and fittings, plumbing, electrical, air conditioning, lifts, generators, security, sprinklers and basement ventilation (GDID, 2015).

Condition Standard Descriptions:

- 5: Assets to be in best possible condition. Only minimal deterioration will be tolerated.
- 4: Assets to be in good condition operationally and aesthetically, benchmarked against industry standards for that particular class of asset.
- 3: Assets to be in reasonable condition, fully meeting operational requirements.
- 2: Condition needs to meet minimum operational requirements only.
- 1: Condition can be allowed to deteriorate or marginally maintained at minimal cost.

(GDID, 2015)

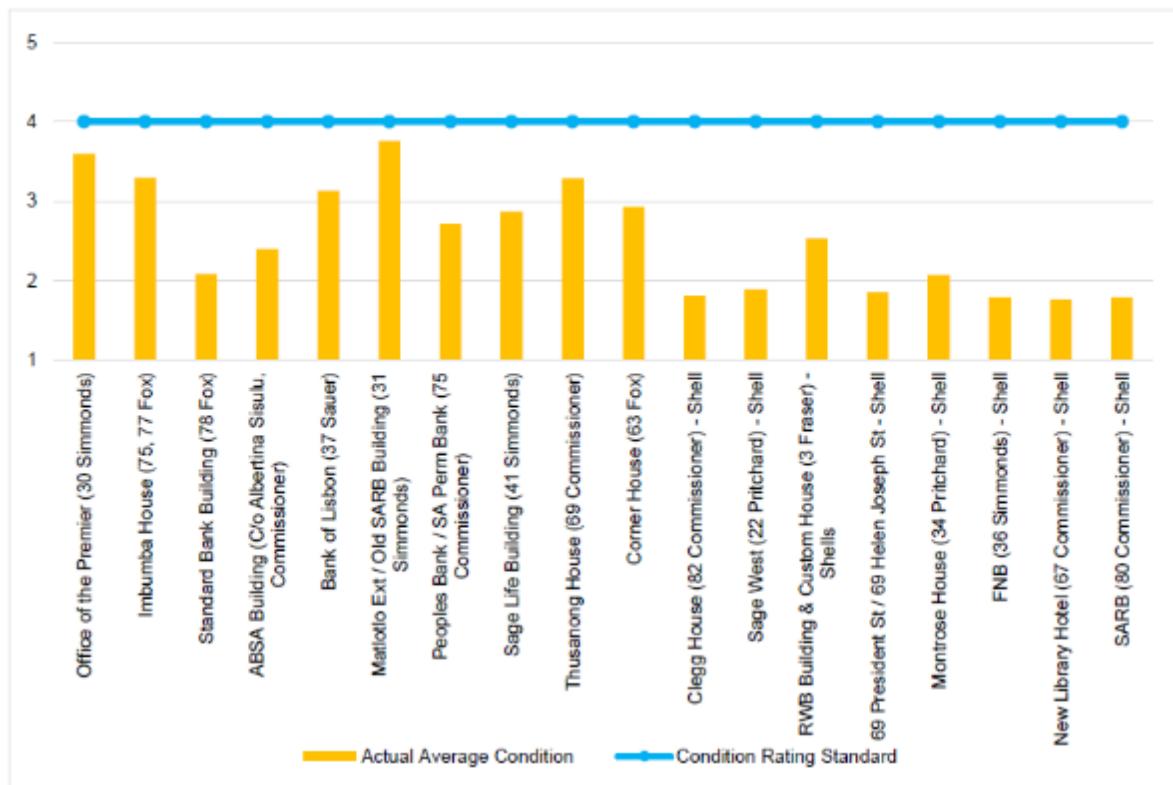


Figure 15. Average condition of Kopanong Precinct buildings in July 2015

(GDID, 2015)

The condition standards are described above and Figure 15 indicates the performances of all precinct buildings against this condition standard. It is apparent that the majority of the precinct buildings are significantly short of meeting the required standard 4 indicated by the blue line.

Below in Figure 16 are more building specific information gathered for each of the Kopanong precinct buildings. The examples below are those of 78 Fox Street and 69 Commissioner Street. This information is useful in informing maintenance and refurbishment decisions in relation to associated costs. This information also highlights trends and similarities between and amongst buildings. Generally, amongst the Kopanong Precinct buildings the RUL (Remaining Useful Life) of finishes, ceilings, fixtures and fittings, plumbing, electrical, air-conditioning and lifts are short term or immediate concerns. These items present the potential to improve on water and energy efficiencies through replacement.

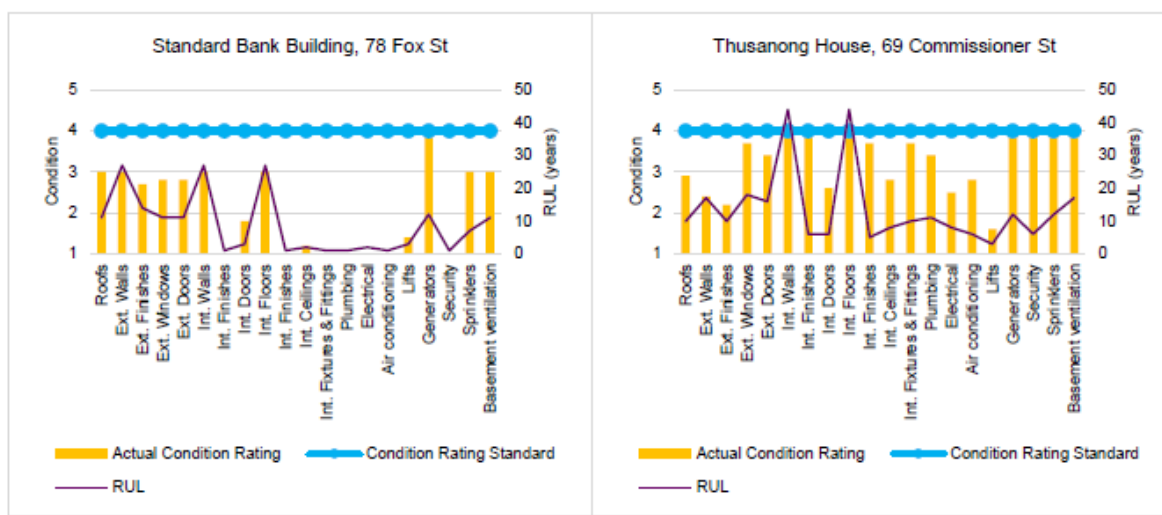


Figure 16. Component-level Condition and Remaining Useful Life

(GDID, 2015)

The cost of improving the conditions and performance of the buildings to meet acceptable standards are established after the component-level assessments are complete. The cost of replacing the asset is also highlighted together with the constructed area of the buildings. The data described below indicates that it generally is more feasible to attend to the building performance and functional requirement provision through maintenance and refurbishment of the existing buildings rather than constructing new. An example highlighted is 78 Fox Street. Approximately 50 000m² of constructed area would require R500 million to replace but has a total maintenance backlog cost of R262 million. On a relatively smaller scale, 69 Commissioner Street of approximately 10 000sqm of constructed area would require R85 million to replace but has a total maintenance backlog cost of R15 million (GDID, 2015).

6.4.8. Please describe the manner in which the brief is developed

6.4.8.1. Requirements, drivers, stakeholders

When buildings are to be refurbished, maintenance plans need to be in place. Refurbishing existing buildings is a huge challenge. Parliament must actively support and invest in sustainable development. Requirements in Johannesburg CBD may be different to challenges and requirements at Durban and Cape Town CBD's.

A key driver is when the lease expires and a lease renewal is sometimes required. The precinct project brings the advantage of owning your building. The investor will charge the government rental for up to 22 years after which time the building will be returned to the state. Leased in buildings also have to be returned to their original state when the lessee is moving out. This can also have a significant financial impact.

SANS regulations to be complied with and occupation certificates are mandatory. Space norms are always challenging especially with existing buildings. This is largely because the

existing spaces available in the existing building are generally not able to optimally accommodate the new functional and spatial requirements.

Treasury is a key stakeholder, the city of Johannesburg as well as the department requiring accommodation.

As per chief architect the Corner House project missed many opportunities at sustainable refurbishment. Select interventions could have been done differently considering the above environmental, social and economic factors. According to the respondent there was very little environmental consideration at the Corner House project.

In the Johannesburg CBD approximately 150 000 m² are leased in by the government. This equates to approximately 12 or 13 buildings. The department pays for the water and lights utility bills so there is motivation and encouragement to implement energy and water wise solutions. The Education department leases this building in. The landlord is not concerned with the fittings because the department is paying the bills.

6.4.9. What are the key areas for improvement (building) noted in the refurbishment process/strategy?

At 6 Hollard, decreased utility bills and meeting the spatial and functional requirements for the department were key areas for improvement. Grey water should be considered but currently none of the current or recent projects considered grey water interventions. The building façade and thermal performance is also not typically considered or addressed due to challenges associated regarding costs and time. The department of agriculture does waste separation in select buildings.

Generally speaking, all buildings that are amended should be improved from a performance perspective. Water saving initiatives and solutions are top of mind although implementation is challenging. Grey water recycling has many complexities that need to be addressed.

At 6 Hollard there was minimal intervention. First, eighth and ninth floor, new carpets, new ceilings, new drywalls and refurbishing of the bathrooms was requested. The Department of Education moved into this building.

Incentivise departments to use space efficiently. In the majority of existing buildings, the space planning does not meet the current trends and space and collaboration requirements.

There is a drive to promote occupancy of existing buildings in Johannesburg CBD. Unoccupied buildings tend to degenerate rapidly when compared to existing building of similar construction and age that are occupied. Fixing buildings will lead to fixing the city.

The Kopanong Precinct buildings have a greater opportunity of holistically addressing social, environmental and economic sustainability impacts. Independent architects will be appointed

and these will form key deliverables that are to be met. The government will oversee the design and construction of the precinct.

6.4.10. Generally, in this context are you able to meet the requirements of the brief?

Yes, for leased in buildings – 6 Holland. We are reusing existing buildings so certainly from a space planning and functional perspective the brief is met. Social considerations are implemented and are key output measures. These including parking, access to public transport, access to local amenities within walking distances as well as access to parks and public spaces.

Yes, for owned buildings as well – Kopanong Precinct. At owned buildings it is certainly more likely to achieve the environmental sustainability goals due to the nature of the ownership status.

Example mentioned; The Empire State building and the replacement or improvement of the existing glazing and the positive impacts it has on energy usage and occupant comfort.

6.4.11. What are the noted improvements in building performance?

Utility bills are an effective means of demonstrating improvement of building performance. The intention in most refurbishment projects is to establish if occupants are now more productive based on their new environment. The respondent indicates that select studies are now indicating that open plan office environments are actually leading to less productive teams when compared to traditional offices and cubicle type work stations.

Historic building data provides average building performance across water and energy. This can be compared to performance after building refurbishment.

6.4.12. Comment: integration of social, economic and environmental factors into planning, implementation and decision-making

The city is trying hard to improve the perception and conditions of the physical environment of the city. This includes, removing waste and litter frequently, pest control, solutions for dilapidated buildings and reducing crime in the city.

6.4.13. Comment: energy assessment and classification, identification of technological solutions for energy efficiency and the integration of renewal systems

Energy assessment and classification has financial benefits. Look to the past and assess what worked then. Adopt and adapt solutions to suit current requirements. The respondent makes reference to the book “barefoot architecture”. Sustainability defined as reusing all available assets in the refurbishment or reuse of space.

Low tech and low maintenance should not be underestimated. Passive design principles and insulated buildings are comfortable and resource efficient buildings. Technology is in the post production.

Respondent suggests we ask our customers for energy and water bill post refurbishment to assess improvements against the performance prior to building refurbishment.

Building Information Modelling (BIM) is becoming commonplace due to information attached for construction and operation benefits and efficiencies. There's also been the introduction or emergence of City Information Modelling (CIM).

Respondent's comments on the definition of energy efficiency and its relationship to renewal systems. What is energy efficiency? Buildings are not the biggest culprit for wasteful use or loss of energy.

6.4.14. Addressing the research objectives

- 6.4.14.1. Analyse the current building stock vis-a-vis the main tenets of green building performance in the public sector.

The case study interactions indicate that the existing building stock is largely inefficient. There are also a number of empty buildings or buildings that are not fully occupied. According to the respondent, empty or dilapidated buildings rapidly degenerate when compared to occupied and fully functioning buildings. *"Empty buildings have the greatest risk of rapidly reaching their end of life. This is a generally accepted concept by owners, occupants and landlords". Respondent 6.4.1.*

Existing buildings will also always face the challenge of being constrained by its existing floor plate and potentially missing the opportunity to optimally accommodate its occupants from a spatial arrangement perspective.

- 6.4.14.2. Collate the relevant policies and frameworks associated with the sustainable refurbishment of existing buildings in South Africa.

Longevity of products and systems should be considered against whole life cycle impacts and life cycle costs. *"The intention is to increase the longevity of products and systems installed in a building. Consider whole life cycle costs. Also consider the impacts of products and systems across its entire lifecycle. Select stages of its lifecycle may have significantly greater impacts on the environment than other stages in the life cycle if the product". Respondent 6.4.1.* SANS regulations and occupation certificates are mandatory and are therefore key considerations. Expiring leases and maintenance cycles also have the ability to impact the decisions or the direction of the refurbishment process. *"A key driver is when the lease expires and a lease renewal is sometimes required. The precinct project brings the advantage of owning your building". Respondent 6.4.1*

- 6.4.14.3. Identify the policy objectives of green building in South Africa.

Key objectives raised in this case study included reductions in energy and water consumption. *“Utility bills are an effective means of demonstrating improvement of building performance”*. Respondent 6.4.1. This was primarily due to government paying the utility bills for energy and water consumption for building which are not owned by government and which they rent. In this instance the landlord is not motivated to address this through more sustainable and efficient solutions as the government is paying the utility bills. The city is also concerned with the perception of users of the environment and streetscapes. *“The city is trying hard to improve the perception and conditions of the physical environment of the city. This includes, removing waste and litter frequently, pest control, solutions for dilapidated buildings and reducing crime in the city”*. Respondent 6.4.1. Through refurbishing of buildings holistically, the city would benefit from these positive contributions of the refurbished buildings to the city. The respondent shared his views that fixing the buildings would lead to fixing the city.

6.4.14.4. Analyse local implementation strategies.

These include, not excluding low tech and low maintenance interventions including passive design principles, water wise fittings and efficient light fittings. The introduction of smart meters in recently refurbished buildings would demonstrate the desired positive results of the sustainable interventions and these could be used to assist the motivation for similar interventions in other buildings. A conditional assessment of buildings within the Kopanong Precinct Project has demonstrated that in most instances it is financially more viable to refurbish an existing building when compared to building a similar building new. An example highlighted is 78 Fox Street. Approximately 50 000m² of constructed area would require R500 million to replace but has a total maintenance backlog cost of R262 million. On a relatively smaller scale, 69 Commissioner Street of approximately 10 000sqm of constructed area would require R85 million to replace but has a total maintenance backlog cost of R15 million (GDID, 2015).

6.4.14.5. Assess the success factors in the implementation of the different solutions and technologies.

Considered and collaborative processes that inform the spatial and functional relationships of work spaces lead to occupant satisfaction. A link between user comfort and productivity is highlighted as a topic of interest. *“The intention in most refurbishment projects is to establish if occupants are now more productive based on their new environment”*. Respondent 6.4.1. Space optimization and planning are challenging in any existing building although success is more likely to be attained in a government owned building when compared to that of a leased in building. This is due to the lack of interest in investing in a building that is not owned by government. Other social considerations including public transport considerations, access to public facilities, parking areas, public amenities and social or collaborative spaces are also more achievable in an instances where government owns the buildings, as would be possible with the Kopanong Precinct Project.

6.4.15. Summary

The discussion commenced with some time being dedicated to the meaning of sustainability and sustainable refurbishment in this study. Sustainable refurbishment here refers to the upgrading of the existing works by considering the facets of sustainability namely; social, environmental and economic

Social aspects and concerns emerge early on in the discussion and feature throughout the engagement. It is apparent that the model considered is focused on a people centred approach to design. Items mentioned included; transport to and from work/home, rest areas, parking areas and dining areas.

The respondent's view is that refurbishing of existing buildings is the most sustainable response when compared to other activities in the built environment. Life cycle assessments of products and life cycle costings of solutions are mentioned as key areas to consider where longevity is concerned.

Like previous interviews and discussions, this case study reiterates that society focuses on hospitals and schools. This is identified as the greatest need and society's needs far outweigh the current financial and human resources available. The department is often challenged on the rationale behind renting buildings rather than using their own building stock. The respondent indicates that it is much more complex and a variety of aspects must be considered. It is attractive and easier to engage a landlord and pay a market related price and not concern yourself with maintenance except changing a light bulb when required. A significant financial impact is associated to returning the leased in building to its original condition when the lease expires and the tenant has to move out.

The Kopanong model detracts from that of the leased in instance. The Kopanong Precinct project aims to invite investors to complete the project and then lease them to the state for a period of time. The Kopanong Precinct buildings have a greater opportunity of holistically addressing social, environmental and economic sustainability impacts. The results of the conditional assessments indicate that the majority of the precinct buildings are significantly short of meeting the required standard 4 rating. Although the conditional assessment depicts a less than favourable scenario, the costs associated with improving building performance and functional requirement are significantly more attractive than constructing new. This further strengthens the case for sustainably refreshing existing buildings. Replacement and maintenance costs for buildings at Kopanong Precinct, also conceals the energy and waste associated with deconstruction or demolishing of the existing, to accommodate for new buildings. A challenge that existing buildings present perpetually is that new tenant layouts are confined to an existing floorplate. There are instances where it is not possible to optimally accommodate the new functional and spatial requirements.

The respondent indicates that a national and general approach to refurbishing existing buildings may not be an effective approach because of regional specific challenges that may require tailored solutions.

Regarding key areas for improvement - decreased utility bills was an identified priority. Installing smart meters and monitoring consumption is occurring and is beneficial. Grey and black water recycling should feature but this is currently only being explored in healthcare and education projects. Understandably, these initiatives are complex and require much consideration and testing. Like the case studies described previously, this study also indicated no attention to improving the performance of the existing building fabric from an acoustic and thermal perspective.

At a city level there is a drive to promote occupancy of existing buildings in Johannesburg CBD. Fixing buildings will lead to fixing the city. Integration of social, environmental and economic factors emerge through the city's drive for improving the perception and physical conditions within the Johannesburg CBD. This includes, removing waste and litter frequently, pest control, solutions for dilapidated buildings and reducing crime in the city.

Requirements of the brief are generally met in both instances; owned and leased in buildings.

An interesting concept that emerged from this discussion was the progress that BIM has made over the past few years and more recently the introduction of CIM. These technological advances are optimising the workflows in the AEC (Architectural Engineering Construction) environment through data rich solutions and connectivity.

The discussion concludes placing emphasis on people again and reinforcing that the overarching concept is creating a better city, and enabling this idea through each intervention at the city from space and building to precinct level. Fundamental is using space efficiently, using less water, less energy and less waste.

6.5. Interview with voluntary association built environment expert

6.5.1. Introduction

The respondent at this interview was a referral by Respondent 5.1.3 during his/her interview in December 2017. This recommendation was presented due to his vast experience in both private and public sector built environments and his passion and dedication to sustainable development.

6.5.2. Project description

The intention was not to focus on a single case study as the respondent is rather focused on market development in his current role and does not necessarily spend much time on a single building project from inception through to completion.

The intention was to present the respondent with the same questions as the previous respondents and obtain his perspective on each of the questions based on his experience and background.

6.5.3. Project scope

Not applicable

6.5.4. Profile of the respondent

Respondent 6.5.1

The respondent is a senior member of a key green building organisation in South Africa that is leading the transformation of the property market ensuring that buildings are designed, built and operated sustainably. The respondent is currently the managing executive for the market engagement unit. This includes; public sector programs and coordination, membership engagement communications and marketing and events and Corporate Social Investment (CSI). The focus in this interview is the public sector.

To advocate for green buildings practice and education in the public. The purpose is to inspire a built environment in which people and planet thrive. To achieve this, government must lead. Government is mandated to serve people.

The call to action is three elements, lead, legislate and facilitate. Green building as a process and green buildings with material and solutions. Legislate, by laws and codes. Facilitate, mechanism for incentivising green building. Work with the private sector. Currently the 7th year with the organisation.

6.5.5. Semi-structured interviews

The interview was conducted on the 28 February 2018 at the respondent's offices in Rosebank, Johannesburg. The discussion commenced at 12:00 and lasted 80 minutes. The respondent completed the consent forms and the meeting was recorded. This is available as appendix 1.

6.5.6. Provide your view on refurbishing of existing buildings.

There are many buildings built considering green building principles although not necessarily rated as Green Star. The primary objective is not to certify buildings but rather to promote the sustainable development of the built environment.

The example noted was that of Constitutional Hill where green building principles were considered but this was prior to any local green building certification scheme. Another example mentioned was that of WWF and black water treatment.

The respondent discusses his suggestion to Johannesburg mayor, Herman Mashaba. Four points; there must be collaborative urban leaders with a clear common vision that is founded on sustainability and resilience, must start with a laser like focus not myopic but clear focus on one core urban service challenge, provide access to and availability of resources both financial and human to deliver and finally a very strong long term political commitment. Mega trends like urbanisation and water scarcity are agnostic to political affiliation. The Corridors of Freedom is an initiative about re-stitching the city because of apartheid spatial planning.

Singapore city state example to drive sustainability. Seoul, South Korea took a decision. Some of the barriers mentioned, State of cities report & South Africa cities network. There is a belief that the old city system drawings may have been deliberately destroyed. If you are running with a ball and chain, then you will be weighed down.

Heritage council may see sustainability differently than the mainstream belief. They see a risk that is different. A historic paint example and low VOC paint discussed as an example to use new and current solutions to maintain. The question raised regarding ownership of land in the city. Who is benefiting?

The largest portion of the building stock is existing and the respondent refers to Alfredo Brillembourg of Urban think tank, Zurich. A lot of the building that we will need in a few years' time is already here. The city wants to build on the outskirts yet we intend to densify the city centre. We don't refurbish for refurbish sake as it is not about removing old windows and installing new with similar performing solutions.

6.5.7. In this context, describe the current state of the refurbishment process from a sustainable development perspective.

6.5.7.1. *Environmental*
 Energy, water, waste

6.5.7.2. *Economic*

6.5.7.3. *Social*

Constitutional Hill project designed from first principles. The designers considered, social sustainability, environmental and economic sustainability. Great symbolism associated with this building. The clients are people and not necessarily academic. Also to be considered is the council chamber.

Sometimes refurbishment is done solely for financial gain, solving an immediate problem and not considering the future. The defining feature of green building or sustainable development is systems thinking. These systems can be seen as the social, economic and environmental aspects.

6.5.8. Please describe the manner in which the brief is developed

6.5.8.1. Requirements, drivers, stakeholders

The brief is often about the thing that must be provided and not necessarily the how it is to be delivered. Whilst you asked to add a floor you should be required to describe the manner and process in which it is delivered.

6.5.9. What are the key areas for improvement (building) noted in the refurbishment process/strategy?

This would depend entirely on the purpose and function of the building as well as the condition of the building. One has to understand the original intention and considerations during development.

6.5.10. Generally, in this context are you able to meet the requirements of the brief?

This question is not applicable in this interview.

6.5.11. What are the noted improvements in building performance?

More often than not it is energy, water and waste. Put measures in place to achieve this. Example of plastic cups and straws and job creation as additional stakeholders are included to achieve the objective. You cannot lock in inefficiencies by not considering future thinking and planning.

6.5.12. Comment: integration of social, economic and environmental factors into planning, implementation and decision-making

This question is not applicable in this interview.

6.5.13. Comment: energy assessment and classification, identification of technological solutions for energy efficiency and the integration of renewal systems

Technological solutions are sometime used as a crutch. Example used of replacing all light fittings to energy saving light bulbs. Changing behaviour of people is key. Building management is key, considering switching off light where not required.

Where technology is speaking of clean energy there we are making progress.

Africa must move into a space where we don't talk about surviving. We should be building smart cars and smart cities. We live in one of the most unequal countries in the world. Technology will always favour the rich. The city will continue to lose revenue and this is being

transferred to the poor. We need to change the way in which we deal with these challenges. A person in Eldorado Park should be able to ask for a green home says the respondent.

EDGE and applicability to single residential homes. We must be wary that the message is not that sustainability is for the privileged. All stakeholders must feel responsible for being inclusionary.

Respondent deliberately did not talk about tools as it narrows the conversation. *Tools are an enabler. Existing Building Performance (EBP) tool does address refurbishment of buildings and energy and water performance is a part of the tool, but can occur separately. The advantage of EBP is that one can certify every three years. The current stats indicate that there is appetite but when you consider the total existing building stock we realise that we are scratching the surface.*

6.5.14. Addressing the research objectives

- 6.5.14.1. Analyse the current building stock vis-a-vis the main tenets of green building performance in the public sector.

This interview reinforces the position that the existing building stock possesses great potential for improved building performance and reducing its impacts on the environment. Refurbishment projects are frequently cosmetic only and in most instances the design brief is not interrogated to the extent that could prompt a sustainable process rather than focussing on delivering the solution. *“We don’t refurbish for refurbish sake as it is not about removing old windows and installing new with similar performing solutions”* Respondent 6.5.1.

- 6.5.14.2. Collate the relevant policies and frameworks associated with the sustainable refurbishment of existing buildings in South Africa.

The respondent indicates that government should lead by example as they are mandated to serve the people and in turn consider the effects of the built environment on the planet. *“The purpose is to inspire a built environment in which people and planet thrive. To achieve this, government must lead. Government is mandated to serve people”.* Respondent 6.5.1.

- 6.5.14.3. Identify the policy objectives of green building in South Africa.

The objective is to inspire a built environment where people and planet thrive. The focus is not necessarily certifying sustainable buildings but rather to promote sustainable development. As per previous case studies this interview also indicates reductions in energy, water consumption and waste reduction as primary objectives. *“More often than not it is energy, water and waste. Put measures in place to achieve this”.* Respondent 6.5.1. These are also considered as mechanisms for job creation and skills development.

- 6.5.14.4. Analyse local implementation strategies.

Lead, legislate and facilitate are some of the key terms emerging from this case study. Green building is a process, with materials and solutions. We should not be refurbishing building only for cosmetic gains. This is not sustainable and delivers minimal long term benefits. Creating awareness and changing behaviour is crucial in improving building performance through energy and water reductions. Technology should not be used as a crutch. *“Example used of replacing all light fittings to energy saving light bulbs. Changing behaviour of people is key. Building management is key, considering switching off light where not required”*. Respondent 6.5.1.

6.5.14.5. Assess the success factors in the implementation of the different solutions and technologies.

The respondent highlights sustainable development as systems thinking and these systems emerge as the social, economic and environmental aspects of development. *“The defining feature of green building or sustainable development is systems thinking. These systems can be seen as the social, economic and environmental aspects”*. Respondent 6.5.1. Green building rating tools are indicating positive results and trends but when these buildings are considered against the total existing building stock then it is clear that there is still great progress to be made and potential to be exposed.

6.5.15. Summary

The respondent commenced with a brief description of his roles and responsibility in his current capacity. A key comment in this early description was the three elements of the GBCSA’s call to action; lead, legislate and facilitate. Government leading by example should be a priority, followed by legislating sustainable development and implementing measures that encourage green building and sustainable development.

Like the interview with the Managing Director of the private architectural practice, respondent 6.5.1 indicated that he was aware of many buildings that considered green principles and implemented green technologies although not certified and rated as Green Star buildings. Constitutionals Hill and the World Wide Fund for Nature (WWF) building in Braamfontein are such examples shared at the interview.

From a political and governmental perspective, the respondent shared his suggestion to the city mayor regarding sustainable development for the city of Johannesburg. These four points include; there must be collaborative urban leaders with a clear common vision that is founded on sustainability and resilience, starting with a laser like focus not myopic but clear focus on one core urban service challenge, provide access to and availability of resources both financial and human to deliver, and finally a very strong long-term political commitment.

Similarly, to previous respondents, respondent 6.5.1. firmly believes that the largest portion of the building stock is existing and these existing buildings provide an opportunity to address future needs through sustainable refurbishment. The existing building stock provide a great potential to improve building performance and reduce consumptions.

Like respondent 6.4.1., respondent 6.5.1’s emphasis is on people and social sustainability being key to sustainable development and sustainable refurbishment. The concept of systems

thinking is raised. In this context, it refers to not only economic sustainability but all three facets of sustainability which must be considered.

An interesting interpretation or description of the brief is presented. The focus of the brief should not necessarily be on what should be delivered but also the manner in which it is delivered.

Key areas for improvement are building and brief-specific. Ideally, the requirements of the brief should be met. The noted improvements are different to the key areas for improvement. In most instances, the noted improvement are reductions in energy consumption followed by water and waste.

Regarding energy assessment and classification, identification of technological solutions, here again the focus is people and their behaviour. People need to be aware and informed of the effects of their behaviour and habits regarding building occupancy and usage. Rather than setting an objective to replace all light bulbs as an energy efficient solution, behaviour change with regards to energy usage should be encouraged.

The concluding remarks were equally direct and encouraging. The respondent suggests that Africa should move to a space where we no longer talk about surviving but rather building smart buildings, smart cities and smart cars. Africans need to change the manner in which they deal with challenges. Sustainable development and green buildings and solutions are for everybody and not just the privileged. The respondent intentionally avoided focusing on Green Star ratings. Statistics indicate that the appetite exists -there is vast potential available.

6.6. Interview with an architect and an environmentalist at GDID Green Technologies Unit

6.6.1. Introduction

During earlier semi-structured interviews with industry experts discussing the case studies including the Kopanong Precinct as well as Corner House and 6 Hollard Street, the GDID Green Technologies Unit was frequently referred to. It was suggested by a few respondents that members of this unit be exposed to the study and offered the opportunity to provide input. Two individuals kindly offered their time to support the development of this research.

6.6.2. Project description

The Corner House project and 6 Hollard Street were the case studies referred to during this discussion. The information and commentary provided was presented from a technology and solutions perspective due to the respondent's focus on green technologies.

6.6.3. Project scope

The project scope for The Corner House project case study and the 6 Hollard Street case study are described in 6.2 and 6.4 above.

6.6.4. Profile of the respondents

Respondent 6.6.1

Studied at Tshwane University of Technology (TUT) and qualified as an architect. Role at GDID is to champion green technologies implementation and to register projects with the GBCSA for GSSA. Ensure the relevant stakeholders are involved where implementation is required. Also responsible for reviewing alternative building technologies. Joined GDID in 2016.

Respondent 6.6.2

An environmentalist with a BSc. From University of KwaZulu-Natal (UKZN). Currently Assistant Director at The Green Technologies Unit. Honours at WITS and currently completing Masters degree at WITS. Employed at GDID from November 2015. She assists in the management of the team and supports the team wherever required.

6.6.5. Semi-structured interviews

The interview was conducted on 19 March 2018 at the respondent's offices at 4th Floor in 18 Rissik Street, Johannesburg. The discussion commenced at 09:00 and lasted 45 minutes. The respondents completed the consent forms and the meeting was recorded. This is available as appendix 1.

6.6.6. Provide your view on refurbishing of existing buildings.

The GDID has two major clients; health and education. There are others including social development and arts and culture but these are relatively smaller clients of the GDID. The

Koponong Precinct is an office project that the department is looking at. The precinct project includes refurbishing a relatively large number of buildings.

Health is the biggest client with a focus on maintenance and refurbishing of existing buildings. Major efforts regarding the maintenance of boilers and improving energy efficiencies. Education projects are new build projects and the maintenance and refurbishment education projects remain the responsibility of the Department of Education.

Integrated energy efficiency project where lighting will be retrofitted and smart meters installed to monitor energy consumption and improvements achieved.

At the time of the interview both respondents were not comfortable enough to discuss the Koponong Precinct due to limited exposure to the project. A project meeting and presentation was pending a few weeks away.

Respondent 6.6.1 indicates that a national norms and standards is required. A mandatory requirement and enforcement is necessary. Voluntary guidelines are not as successful. Climate change is real. We need to mitigate and not adapt to environmental changes.

6.6.7. In this context, describe the current state of the refurbishment process from a sustainable development perspective.

6.6.7.1. *Environmental*
 Energy, water, waste

6.6.7.2. *Economic*

6.6.7.3. *Social*

At the Koponong Precinct project the drive is to consider energy, waste and water and implement solutions to improve performance and reduce the usage. Roof top solar will power all lighting. Cogeneration solutions to provide up to 50% of the energy requirement. The intention for wc flushing water is to be complete waste water treatment systems at all office buildings in future. Hospitals and schools were the first projects that these solutions were implemented.

There is a major shift toward implementing of green technologies in new and refurbishment projects. The guidelines, Green Building Policy signed in 2013 by the HOD and this drives the green technologies implementation. Dr. Chimusoro founded this unit and appointed the professionals to implement strategies and solutions.

6.6.8. Please describe the manner in which the brief is developed

6.6.8.1. Requirements, drivers, stakeholders

Ideally, a project team should include The Green Technologies Unit from the design and planning stage. The brief could then be developed in conjunction with the green unit. It is easier to implement technologies and solutions at the start of a project rather than aim to retrofit after completion or even during the design development or construction stages.

Currently this is not necessarily the case. The Green Technologies Unit is often called in during the design and development stages and are required to support only where required or intended.

Education and health have their own professional teams including architects, designers and engineers. The Green Technologies Unit aim to track the project after they are involved ensuring that technologies and solutions that are intended are in fact implemented.

6.6.9. What are the key areas for improvement (building) noted in the refurbishment process/strategy?

Both respondents agree that energy, water and waste reductions are key areas for improvement.

Hillbrow Hospital is aiming for 5 Star GSSA. The Kopanong Precinct buildings will be targeting Green Star South Africa certification.

6.6.10. Generally, in this context are you able to meet the requirements of the brief?

Yes.

The manner in which The Green Technologies Unit currently operate is that of “plug-in” and “plug-out”, supporting on a particular project only where requested to do so. The unit is not involved in a project from design stages through to completion. Individual departments have their dedicated professional teams who call on the expertise of The Green Technologies Unit for either; energy saving technologies, water saving technologies as well as waste diversion.

6.6.11. What are the noted improvements in building performance?

Corner House case study installation mentioned. A floor by floor pilot partial refurbishment. Smart meters where installed at Corner House project and usage is now being measured and monitored. A clear improvement in performance is noted.

6.6.12. Comment: integration of social, economic and environmental factors into planning, implementation and decision-making

The Kopanong Precinct Project presents the greatest opportunity to consider and integrate all social, economic and environmental factors into the design for implementation. This will assist the project in meeting its primary objectives of improving administration efficiencies.

Some key tactics that will be considered at the Kopanong Precinct include; implementing the latest feasible green technologies to reduce carbon emissions and consumption of water and energy, implement design elements that facilitates the interaction of the community members from different socio economic backgrounds, retail and service offerings within and around the precinct to support the increased number of people within the precinct, apply structural

principles that support well performing precinct, central back of house functions, ground floor rentals as well as skills development and job creation.

6.6.13. Comment: energy assessment and classification, identification of technological solutions for energy efficiency and the integration of renewal systems

Rooftop solar project roll out phase one in progress and phase two is close to implementation. Co gen plant pilot taking place at Chris Hani Baragwanath Hospital.

Water saving measures, efficient eco cisterns, aqua trip water saving, recycling waste water, bio-digesters at schools for cooking. Cooking, waste is converted to energy to support nutritional schemes. Waste water treatment plants in schools and clinics. Plant is installed with three filter tanks which is a closed system. Wc is flushed and waste is collected in first tank where it settles before moving down to second and third tanks. The Green Technology Unit won an award for the waste water recycling in 2017. In 2018 the unit won an award for gas supply. All boilers are converted from coal to gas. Rather than use coal to create heat the unit is now implementing gas. Going forward all clinics will be waste water treatment installations as well as rooftop solar on all new projects in future to supply energy for lighting. Power generated on the weekend will be fed back into the grid at no cost to the local municipalities.

6.6.14. Addressing the research objectives

- 6.6.14.1. Analyse the current building stock vis-a-vis the main tenets of green building performance in the public sector.

Insights gleaned from this case study indicate that the design and decision making progress, in a refurbishment project, has the potential to improve especially regarding the involvement of key stakeholders at the earliest of stages rather than later. *“The brief could then be developed in conjunction with the green unit. It is easier to implement technologies and solutions at the start of a project rather than aim to retrofit after completion or even during the design development or construction stages”.* Respondent 6.6.1.

- 6.6.14.2. Collate the relevant policies and frameworks associated with the sustainable refurbishment of existing buildings in South Africa.

One of the respondents at this case study indicated that national norms and standards are required. A mandatory enforcement is required as voluntary standards and guidelines are not as effective when compared to the former. *“A mandatory requirement and enforcement is necessary. Voluntary guidelines are not as successful. Climate change is real. We need to mitigate and not adapt to environmental changes”.* Respondent 6.6.1.

- 6.6.14.3. Identify the policy objectives of green building in South Africa.

At the Kopanong Precinct project the drive is to consider energy, waste and water and implement solutions to improve performance and reduce the usage. The Green Technologies

Unit can facilitate the implementation of energy saving technologies, water saving technologies as well as waste diversion. *“Cogeneration solutions to provide up to 50% of the energy requirement. The intention for wc flushing water is to be complete waste water treatment systems at all office buildings in future”*. Respondent 6.6.1. The case study reveals that the integration all social, economic and environmental factors into the design is the key driver for sustainable development. *“The Kopanong Precinct Project presents the greatest opportunity to consider and integrate all social, economic and environmental factors into the design for implementation. This will assist the project in meeting its primary objectives of improving administration efficiencies”*. Respondent 6.6.2.

6.6.14.4. Analyse local implementation strategies.

An integrated energy efficient project is underway where existing light fittings are replaced with energy efficient alternatives and smart meters are being installed to measure performance. Rooftop solar interventions are aimed providing all of the energy required for lighting. *“Roof top solar will power all lighting”*. Respondent 6.6.1. *“Rooftop solar project roll out phase one in progress and phase two is close to implementation. Co gen plant pilot taking place at Chris Hani Baragwanath Hospital”*. Respondent 6.6.1. The focus currently for the green technologies unit is the healthcare and education sectors. Successes enjoyed in these sectors would possibly be adapted and adopted for office buildings.

6.6.14.5. Assess the success factors in the implementation of the different solutions and technologies.

Addressing social imbalances in societies is a key issue that is envisaged to be addressed through the execution of the Kopanong Precinct Projects. *“Some key tactics that will be considered at the Kopanong Precinct include; implementing the latest feasible green technologies to reduce carbon emissions and consumption of water and energy, implement design elements that facilitates the interaction of the community members from different socio economic backgrounds, retail and service offerings within and around the precinct to support the increased number of people within the precinct, apply structural principles that support well performing precinct, central back of house functions, ground floor rentals as well as skills development and job creation”*. Respondent 6.6.1. Water saving, water recycling, waste recycling and diversion from landfill as well as alternate energies for cooking are some successes enjoyed at education and healthcare facilities. The green technologies unit has won awards in 2017 and 2018 for water recycling and gas supply initiatives.

6.6.15. Summary

The Green Technologies Unit primary focus areas are both healthcare and education sectors. Therefore, most efforts are focused in these two sectors through new solutions testing and implementations. The healthcare sector is the biggest client and major refurbishment projects are yielding positive results in terms of energy and water reductions in consumption.

Generally, in the healthcare sector the improvements are as a result of replacing the existing boilers and other mechanical systems.

The Green Technologies Unit focuses on new projects primarily in the education sector. Current successes include; energy reductions in consumption through rooftop solar technologies, water reductions in consumption through recycling and rainwater harvesting initiatives, diversion of waste from landfills through waste separation and recycling initiatives.

This discussion also presented the suggestion that a national norms and standards should be finalised and implemented as this is required at this stage to effect change. The current voluntary guidelines are not as successful as intended according to the respondents in this interview.

The Green Technologies Unit do provide support on office projects upon request. The Corner House project is a good example of this as solutions implemented at this project are being monitored and the results recorded are positive.

The Kopanong Precinct Project is intended to implement the maximum and optimum combination of green technology solutions according to the respondents at this interview. These would include but are not limited to; rooftop solar, efficient lighting, cogeneration solutions, recycled water for flushing toilets and waste separation and recycling. A key focus is also the social facet of sustainable development. These include; implement design elements that facilitates the interaction of the community members from different socio-economic backgrounds, retail and service offerings within and around the precinct to support the increased number of people within the precinct, central back of house functions, ground floor rentals as well as skills development and job creation. The Kopanong Precinct buildings will be targeting Green Star South Africa certification - it would be encouraging for government to lead the industry, and promote and prompt sustainable development.

Both respondents at this interview confirm that ideally, sustainable development and refurbishment considerations and decisions should be deliberated at the earliest stage of the project. It becomes increasingly challenging to implement these solutions successfully if they are introduced later on in the design process.

6.7. Interview with private practice MD for an Architecture and Project Management consultancy

6.7.1. Introduction

The intention with this interview was to obtain feedback from an independent private sector architect in order to understand if some similarities exist between refurbishment of existing buildings in the private and public sectors.

6.7.2. Project description

The intention was not to focus on a single case or project but rather to obtain general feedback based on previous and current projects.

6.7.3. Project scope

This respondent's consultancy is currently primarily occupied with refurbishment of existing buildings when compared to new building projects – 90%/10% split.

6.7.4. Profile of the respondents

Respondent 6.7.1.

The respondent has a total of 11 years of experience in architecture and the built environment. He has been involved in the inception and completion of work on over 100 projects ranging in construction cost from R2.5m to R1.32 billion in different countries on the African continent. His private practice was founded in 2013.

6.7.5. Semi-structured interviews

The interview was conducted on 14 February 2018 at the respondent's offices at Pongola Street, Sandton, Johannesburg. The discussion commenced at 11:00 and lasted 45 minutes. The respondent completed the consent forms and the meeting was recorded. This is available as appendix 1.

6.7.6. Provide your view on refurbishing of existing buildings.

Clients are more aware and demanding now compared to previous years regarding sustainable development and implementing sustainable solutions. The respondent indicates that current scenario in the practice is a split with the majority for refurbishment vs new buildings currently at 90% vs 10%.

6.7.7. In this context, describe the current state of the refurbishment process from a sustainable development perspective.

- 6.7.7.1. *Environmental*
 Energy, water, waste
- 6.7.7.2. *Social*
- 6.7.7.3. *Economic*

Apply basic design principles with the intention to design responsibly. The intention is not to target Green Star certification or rating specifically although we may already be making good progress toward a Green Star rating.

Green technologies currently being implemented on refurbishment projects include rooftop solar solutions and LED lighting solutions. Rainwater harvesting and diverting waste from landfill is also becoming more commonplace. Existing buildings have constraints including circulation space; orientation, massing and floor plates. Not often do we have the budget to demolish portions and redo to correct the wrongs of the past.

6.7.8. Please describe the manner in which the brief is developed

6.7.8.1. Requirements, drivers, stakeholders

This depends on the type of project. Retail decision drivers are tenants. Leases are approaching expiry and the building does not functionally meet the new tenant requirements. Marketability also plays a key role.

In the commercial environment a current trend identified is condensing and compacting of space requirements. Further, business units and brands are consolidating and sharing resources and functions. Owners and developers are striving for optimisation and gaining efficiencies.

6.7.9. What are the key areas for improvement (building) noted in the refurbishment process/strategy?

Energy and water consumption is increasingly becoming a key driver and fundamental aspect of the design brief.

6.7.10. Generally, in this context are you able to meet the requirements of the brief?

Yes, we are.

6.7.11. What are the noted improvements in building performance?

Energy and water reductions in consumption. Smart meters are usually installed and improvements can be seen here.

Examples described, 3000sqm existing building but tenant required an additional 2000sqm. The designers proposed a revised scheme up to 5000sqm. Through this design development and detailed space planning the tenant realised that the original 3000sqm was sufficient and required re organising or replanning the existing space.

6.7.12. Comment: integration of social, economic and environmental factors into planning, implementation and decision-making

Economic factors are more often a priority especially in retail and commercial environments. The owners and developers must ensure the optimum return on investment in order to demonstrate positive results to shareholders. Often this places tremendous pressure on the design team and design decisions although this more often results in creative means of achieving a desirable balance.

The integration of environmental and social factors is now almost standard at every project. The respondent reiterates that they are certain that they are already implementing most measures as outlined in the green star certification process and we intend intentionally pursuing this in the near future. Health and well-being addressed through the creating or allocation of social spaces and platforms are also a driver for current design. Pause areas, collaboration spaces, reading and dining spaces are key areas on a typical commercial floor plan.

6.7.13. Comment: energy assessment and classification, identification of technological solutions for energy efficiency and the integration of renewal systems.

Green technologies currently being implemented on refurbishment projects include rooftop solar solutions and LED lighting solutions. Rainwater harvesting and diverting waste from landfill is also becoming more commonplace.

6.7.14. Addressing the research objectives

- 6.7.14.1. Analyse the current building stock vis-a-vis the main tenets of green building performance in the public sector.

Energy and water consumption is also a key point of departure in the private sector at early design stage of the project as well as the public sector. *“the current scenario in the practice is a split with the majority for refurbishment vs new buildings currently at 90% vs 10%”.* Respondent 6.7.1.

- 6.7.14.2. Collate the relevant policies and frameworks associated with the sustainable refurbishment of existing buildings in South Africa.

Owners, developers and investors are all looking to maximise their investments. Efficiency and optimization are critical factors shared by stakeholders. These efficiencies are gained through sharing of resources, spaces and functions. *“Further, business units and brands are consolidating and sharing resources and functions. Owners and developers are striving for optimisation and gaining efficiencies”.* Respondent 6.7.1.

- 6.7.14.3. Identify the policy objectives of green building in South Africa.

Objectives identified in this case study are not unique and the include energy and water reductions as well as waste reductions. *“The respondent reiterates that they are certain that they are already implementing most measures as outlined in the green star certification process and we intend intentionally pursuing this in the near future”.* Respondent 6.7.1.

6.7.14.4. Analyse local implementation strategies.

The objectives above are addressed through roof top solar interventions as well as LED light fittings replacing existing light fittings at refurbishment stage or planned for next maintenance cycle. Recycling initiatives are intensifying paying particular attention to education and awareness of occupants. Increasingly, social factors are key drivers in the design process. *“Health and well-being addressed through the creating or allocation of social spaces and platforms are also a driver for current design. Pause areas, collaboration spaces, reading and dining spaces are key areas on a typical commercial floor plan”*. Respondent 6.7.1.

6.7.14.5. Assess the success factors in the implementation of the different solutions and technologies.

The installation of energy and water meters at recent projects demonstrate the successes of implemented interventions per project. Space optimization through a collaborative design development approach has proven to be a sustainable and successful solution based on user feedback. *“Rainwater harvesting and diverting waste from landfill is also becoming more commonplace”*. Respondent 6.7.1.

6.7.15. Summary

According to the respondent, client demand is an overwhelming driver for sustainable development and efficient solutions and technologies in building projects. This particular consultancy is currently occupied with 90% of the projects being existing building refurbishment projects.

In agreement with the voluntary association built environment expert, respondent 6.5.1, this respondent also indicates that many green building principles and responsible design decisions are being made and implemented currently. These projects are not necessarily targeting for Green Star certifications. This respondent says confidently that his clients and his projects are already making good progress in the quest for sustainable development and green buildings.

The challenges and restraints that existing buildings provide are similar to those highlighted by the other respondents and these include; circulation space; orientation, massing and floor plates which make adapting to different functional and spatial requirements complex. The respondent indicates that often the project budget determines which of the challenges are able to be addressed and to what extent.

Regarding development of the project brief and drivers, the respondent repeats the sentiments of other respondents. Expiring leases and building adaptability together with asset marketability are all drivers of the development of the brief. The current trend supports space optimisation, and condensing and compacting of space requirements. The clients are aiming for improving efficiencies.

Like in the public sector, the private sector also identifies energy and water reductions as key areas for improvement, while energy and water reductions are also noted as improvements in building performance post refurbishment.

In the retail environment, economic factors take precedent and drive the design and implementation in most instances due to the owners and developers desire to optimise their return on investment. The respondent indicates that these are instances where the architects rely on creative design solutions.

Like in the public sector, the integration of environmental and social factors is a minimum requirement in most projects. The respondent notes that the health and well-being of building occupants is very important, hence these aspects are considered throughout the design development stage. Health and well-being aspects are addressed through creating or allocating social spaces, and platforms are also a driver for current design. Pause areas, collaboration spaces, reading and dining spaces are key areas on a typical commercial floor plan

Chapter 7: Cross case analysis

7.1. Analysis and findings

The analysis of the individual case studies is now followed by a cross case study analysis. This cross case study analysis will highlight the trends and commonalities across the cases.

7.2. Analysis of the semi-structured interviews

7.2.1. Provide your view on refurbishing of existing buildings.

Respondent 6.1.1. asks the question, "If you don't do the PPP, what will you do?". He expresses his view strongly that this is the optimum solution to the challenge being faced. Respondent 6.2.1. who is the director at the project management department indicated that the refurbishment periods are cyclical and vary between 5 and 10 years. He also indicated that user dissatisfaction frequently prompted refurbishment projects. Respondent 6.4.1. also identified the social aspects and concerns as a driver for refurbishment. This respondent is also chief architect and he adds that refurbishing of existing buildings is the most sustainable response when considered against other activities in the built environment.

Respondent 6.5.1. who is an executive at a green building voluntary association commented that there are many buildings built considering green building principles although not necessarily rated as Green Star. The primary objective is not to certify buildings but rather to promote the sustainable development of the built environment. The two respondents from the green technologies directorate indicated their commitment to the green agenda but also indicated that the current focus is the healthcare and education sector. They also suggested that a national norms and standards is required. The respondent currently engaged in a private consultancy indicated that his clients are more aware and demanding now compared to previous years regarding sustainable development and implementing sustainable solutions.

7.2.2. In this context, describe the current state of the refurbishment process from a sustainable development perspective.

- 7.2.2.1. *Environmental*
Energy, water, waste
- 7.2.2.2. *Social*
- 7.2.2.3. *Economic*

Respondent 6.1.2, the Deputy Director for Lease Management at the Gauteng Department of Infrastructure Development, indicates that in essence we are fixing the landlords buildings in a leased building scenario. In instances where government departments lease a building, the landlord drives the refurbishment and costs are included in the rentals. Respondent 6.2.1 reaffirms government commitment to green initiatives and sustainable development. He indicates that wherever possible, mechanical, electrical and water systems are replaced with more efficient solutions. Social awareness efforts are implemented and these are maximised wherever possible. Challenge areas raised include; effecting change to existing facades as well as waste separation and diverting waste from landfill - related to both construction and operation waste.

The Pritchard Street case study was unique - although it was a leased in building the government stakeholders were able to inform decisions made during refurbishment. The building was an unoccupied and dilapidated building, therefore all electrical, mechanical and water systems were new installations. All efficient electrical, mechanical and water systems were implemented. The chief architect, respondent 6.4.1. indicates that longevity of products and systems is key hence life cycle costs and full life cycle product assessments should inform the decision making. In the city centre the precinct project (Kopanong Precinct Project) takes precedent over other (isolated) refurbishment projects. The optimum ratio of sustainability measures will be implemented at the precinct project. Environmental and social impacts have been carefully considered at the precinct project.

Respondent 6.5.1 reiterates that sometimes refurbishment is done solely for financial gain, solving an immediate problem and not considering the future. The defining feature of green building or sustainable development is systems thinking. These systems can be seen as the social, economic and environmental aspects. Both respondents 6.5.1 and respondent 6.7.1. agree independently that the most basic design principles should be considered in all refurbishment projects with the intention to design responsibly considering people, planet and profit.

7.2.3. Please describe the manner in which the brief is developed

7.2.3.1. Requirements, drivers, stakeholders

Respondent 6.1.1. comments that the brief is developed on various interpretations of full life cycle refresh. The brief is also frequently initiated by departments undergoing expansion or reorganisation. According to respondent 6.2.1, occupant dissatisfaction and compliance concerns are also drivers prompting the development of a design brief. This respondent is also director of project management at GDID and indicates that in instances his team is responsible for developing the brief. In instances where strategic buildings are identified as contributors to a sustainable system, these buildings are decanted to allow for this development.

Respondent 6.4.1. comments that parliament should actively support and invest in sustainable development. Expiring leases are also a key indicator for refurbishment and often prompts the development of a brief. The development of the brief should receive input from all key stakeholders in order to achieve maximum benefits and results, indicates respondent 6.4.1. Respondent 6.5.1 introduces a different view of the brief. He says that often the brief indicates what is to be delivered and not necessarily how, or the manner in which the objective should be met. This is the opportunity where sustainable solutions requiring sustainable decisions should be built into the brief.

Respondents 6.6.1 and 6.6.2 echo the sentiments of respondent 6.4.1 in that the brief should receive inputs from The Green Technologies Unit and other key stakeholders at the earliest opportunity to aim for maximum delivery on the project.

7.2.4. What are the key areas for improvement (building) noted in the refurbishment process/strategy?

Respondent 6.1.1. indicates that the key area for improvement is functional availability equating to SLAs. The comment is provided within the context of the Kopanong Precinct Project and the delivery of all 18 buildings. One of the goals of this project is to consolidate government head offices into a precinct, a tightly confined area and efficient services zone.

Respondent 6.2.1. advises that office space for government is a key priority and parking spaces and allocation is a challenge. The issue of waste in the city centre and waste generation from operation of buildings is also an area for improvement and is more challenging in office projects when compared to schools and hospitals. Reductions in consumption of energy and water were key areas for improvement at both The Corner House and Pritchard Street case studies. Typically, improving the performance of the external façade is one of the least prioritised items.

Respondent 6.4.1 commences with the focus for improvement being space optimisation and functionality. This respondent suggested that departments should be incentivised to use space more efficiently. This is followed by water recycling initiatives. As per respondent 6.2.1, respondent 6.4.1 also cites improving the performance of the external façade as a lesser priority. Generally speaking, all buildings that are amended should be improved from a performance perspective. There is a drive to promote occupancy of existing buildings in Johannesburg CBD as indicated by respondent 6.2.1. Respondent 6.4.1. comments based on experience that unoccupied buildings tend to degenerate rapidly when compared to existing buildings of similar construction and age that are occupied. Fixing buildings will lead to fixing the city. The Kopanong Precinct buildings have a greater opportunity of holistically addressing social, environmental and economic sustainability impacts, says respondent 6.4.1.

Respondents 6.6.1 and 6.6.2 both indicate that energy, water and waste reductions are key areas for improvement. This view is shared by respondent 6.7.1.

7.2.5. Generally, in this context are you able to meet the requirements of the brief?

The response here was an overwhelming yes. Respondent 6.6.1 was cautious in his response. “We won’t and cannot betray the brief but we are going to have to go in at the bottom range” says respondent 6.1.1. Respondent 6.2.1. and respondent 6.4.1. indicate that space, functionality and safety requirements were non-negotiable but waste separation and recycling initiatives are frequent challenge areas due to education, awareness and behaviour change.

Social considerations are implemented and are key output measures. These include parking, access to public transport, access to local amenities within walking distances as well as access to parks and public spaces, reports respondent 6.4.1. The Green Technologies Unit are successful in meeting the requirements of the brief as they are viewed as a “plug-in” and “plug-out” service provider.

7.2.6. What are the noted improvements in building performance?

Spatial allocation and functionality as well as user satisfaction were cited as noted improvements by respondents 6.1.1, 6.1.2 and 6.2.1. Positive user feedback has been received and occupants report improved levels of comfort at both The Corner House and Pritchard Street case studies.

Respondent 6.4.1. indicates that reduced utility bills that are demonstrating cost saving are a significant notable improvement. This respondent also reports that the one of the aims is to establish if the improved working environment leads or affects a more productive workforce. Respondent 6.5.1 agrees that more often than not, it is reduced consumption of energy, water and waste. This respondent advises that inefficiencies cannot be locked in by not considering future thinking and planning. The two respondents from The Green Technologies Unit also support the reductions in energy and water consumptions as notable improvements. They indicate that in both The Corner House and Pritchard Street case studies, smart meters were installed which is monitoring consumption, and meeting expectations. Respondent 6.7.1, the private architect agrees with the sentiments of the green technology unit and also bases his comments on recent projects where smart meters were installed and delivered the expected results.

7.2.7. Comment: integration of social, economic and environmental factors into planning, implementation and decision-making

Throughout the interviews all respondents associated with the GDID referred to the Kopanong Precinct Project where social, economic and environmental factors would be integrated optimally into the design and development of the precinct. Respondent 6.1.1. comments that one of the goals of this project is to consolidate government head office into a precinct, a tightly confined area and an efficiently serviced zone. Respondent 6.4.1. indicates that the city is trying hard to improve the perception and conditions of the physical environment of the city. This includes significant efforts to improve the user experience of the city.

The respondents from The Green Technologies Unit confirm that key tactics will be effected at the Kopanong Precinct Project. This will include the latest feasible green technologies; carbon emissions reductions as well as water reduction strategies. Social strategies are also integral including interaction, collaboration, employment, skills and retail mechanisms.

The private sector architect, respondent 6.7.1. reports that the integration of environmental and social factors is now almost standard at every project. Health and well-being addressed through the creation or allocation of social spaces and platforms are also a driver for current design. Pause areas, collaboration spaces, reading and dining spaces are key areas on a typical commercial floor plan.

7.2.8. Comment: energy assessment and classification, identification of technological solutions for energy efficiency and the integration of renewal systems.

Respondents 6.1.1, 6.1.2 and 6.2.1 raised the rooftop garden concept, rooftop solar initiatives as well as integration of smart meters with solar initiatives. Respondent 6.2.1. confirmed that no monitoring systems or significant technological solutions are implemented in buildings that are not owned by government.

The chief architect, respondent 6.4.1., indicated that energy assessment and classification has financial benefits based on recent projects. Low technology and low maintenance should not be underestimated. BIM is becoming commonplace due to information attached for construction and operation benefits and efficiencies. There has also been the introduction or emergence of CIMS (city information modelling). This respondent challenges with the statement that buildings are not the biggest culprit for wasteful use or loss of energy.

The voluntary association expert comments that technological solutions are sometimes used as a crutch. Example used of replacing all light fittings to energy saving light bulbs. However, changing behaviour of people is key and in instances very practical and easy to implement.

Respondents 6.6.1 and 6.6.2 from The Green Technologies Unit provided much feedback to this question although most of the initiatives are focused and directed to health and education projects. Some examples include; water saving measures, efficient eco-cisterns, aqua trip water saving, recycling waste water and bio-digesters at schools for cooking. Waste water treatment plants in schools and clinics and all boilers are being converted from coal to gas. Power generated on the weekend will be fed back into the grid at no cost to the local municipalities.

Respondent 6.7.1. who is active in the private sector shared similar feedback by commenting that green technologies currently being implemented on refurbishment projects include rooftop solar solutions and LED lighting solutions. Rainwater harvesting and diverting waste from landfill are also becoming more commonplace.

7.3. Summary

The cross case analysis is comprehensive and rich in terms of converging the various viewpoints of the respondents onto a focus theme. These various positions are considered and key elements extracted and summarized at each of the themes. These will be presented at the conclusions and recommendations of this study, Chapter eight.

Chapter 8: Conclusions and recommendations

8.1. Introduction

This chapter includes a summary of the study in relation to the research objectives, a summary on the findings and conclusions based on the themes identified as well as recommendations presented through barriers and opportunities that emerged from the semi-structured interviews. This chapter is concluded with directions for future research which have emerged from this study.

8.2. Summary of the Study

The aim of the study was to identify the contextual barriers and opportunities pertinent to the sustainable refurbishment of existing public sector office buildings in the inner city area of Johannesburg, South Africa

The main point of the comparative case study approach was to explain how the three different contexts (leased buildings occupied but not owned by government, buildings occupied and owned by government and government owned buildings that are to be refurbished through a public private partnership model) influence the success of a refurbishment process. Identify the contextual barriers and opportunities within the cases and consider how to tailor the refurbishment process to achieve the intended outcomes if possible or practical.

The study has been successful in clearly addressing the aim of the research. This was to identify the contextual barriers and opportunities pertinent to the sustainable refurbishment of existing public sector office buildings in the inner city area of Johannesburg, South Africa.

Successfully addressing the aim of the study was achieved through constantly alluding to the research objectives throughout the study. The analysis of the current building stock vis-a-vis the main tenets of green building performance in the public sector was highlighted at the Chapter two in the literature review where the refurbishment of existing buildings in the South African context was expounded upon. This topic was discussed in greater detail at chapter 3, Status of the current building stock vis-a-vis the main tenets of green building performance in the public sector.

The relevant policies and frameworks associated with the sustainable refurbishment of existing buildings in South Africa was explored comprehensively in Chapter four, Policies and frameworks pertinent to sustainable development of the built environment for both new and existing buildings. The policy objectives of green buildings in South Africa was also highlighted in this chapter of the study.

Local implementation strategies were analysed at Chapter six through four case study examples. Each of these included an introduction, project description, project scope, profile of the respondents, semi-structured interviews, addressing the research objectives and a summary. Also included in this chapter was three additional semi-structured interviews which

were not case specific but rather focused on the general experience and expertise of the respondents as participants in the development of the built environment. These were followed by cross case analysis and the success factors in the implementation of the different solutions and technologies were also assessed at each of the cases.

This study was structured in this manner to effectively address each of the research objectives and therefore clearly demonstrates that the main problem of the study has indeed been addressed.

The questions in the semi-structured interviews were based on themes that emerged from the literature review. The themes are as follow:

1. One of the key themes or messages revealed from the literature review are the descriptions and extent of typical refurbishments. Cosmetic refurbishments include those projects where building finishes and fittings are replaced and these are not intended to yield improved building performance.
2. The refurbishment process varies from project to project and this is also dependant on the extent of refurbishment as well as the expected results or outcomes.
3. There is a lack of uniformity in the manner in which the brief is developed. The non-conformity is largely due to the varying expectations as well as the type of building and stakeholders involved. The owner of a building driving the refurbishment process will be able to have a greater influence on the process when compared to a tenant in a leased building.
4. The key areas for improvement also vary per project
5. There is an elusiveness of brief adherence that is apparent.
6. A noted enhancement of performance where stipulated in the brief.
7. Instances where the refurbishment falls short of encompassing the three major facets of sustainability; social, economic and environmental.
8. The lack of systematic classification of building performance that affects/influences the manner in which building performance is reported.

8.3. Conclusions

Refurbishment of existing buildings is considered the most sustainable response when considered against other activities in the built environment. Promoting sustainable development and green building principles is critical toward a more sustainable built environment. The government is committed to sustainable development and the green agenda and this is evident through the various programs, policy, pending legislation, dedicated teams and proposed major projects including the Kopanong Precinct project.

From the three models contained in this study; leased buildings occupied but not owned by government, buildings occupied and owned by government and government owned buildings that are to be refurbished through a public private partnership model, the latter is found to be the most promising model offering maximum positive impact in terms of improved building performance and sustainable development.

The research revealed that often the brief indicates what is to be delivered and not necessarily how, nor the manner in which the objective should be met. This is the opportunity where sustainable solutions requiring sustainable decisions should be built into the brief. The brief should receive inputs from The Green Technologies Unit, sustainability consultants or experts in field and other key stakeholders at the earliest opportunity in order to aim for maximum delivery on the project.

The study reveals that reductions in consumption of energy, waste and water were key areas for improvement. This is followed by water recycling initiatives. Space optimisation and functionality should be encouraged through incentivising departments to use space more efficiently. Office space for government within the city centre is a key priority and parking spaces and allocation is also a challenge. There is a drive to promote occupancy of existing buildings in Johannesburg CBD. Fixing buildings will lead to fixing the city.

Space, functionality and safety requirements were non-negotiable but waste separation and recycling initiatives are frequent challenge areas due to education, awareness and behaviour change. One of the major issues raised was that social amenities and considerations are implemented and are key output measures. These including parking, access to public transport, access to local amenities within walking distances as well as access to parks and public spaces. Emerging challenges also included effecting change to existing facades due to perception and lack of data demonstrating benefits gained from interventions implemented.

A review of responses from all respondents associated with the GDID referred to the Kopanong Precinct Project where the integration of social, economic and environmental factors would be integrated optimally into the design and development of the precinct.

The research reveals that the city is trying hard to improve the perception and conditions of the physical environment of the city. This includes significant efforts to improve the user experience of the city. The integration of environmental and social factors is now almost standard at every project. Health and well-being addressed through the creation or allocation

of social spaces and platforms are also a driver for current design. Pause areas, collaboration spaces, reading and dining spaces are key areas on a typical commercial floor plan.

A review of responses from respondents indicated that energy assessment and classification have financial benefits based on recent projects. Low technologies and low maintenance should not be underestimated. BIM is becoming commonplace due to information available for construction, and operation benefits and efficiencies. There has also been the introduction or emergence of city information modelling (CIM).

The study revealed that rooftop garden concepts, rooftop solar initiatives as well as integration of smart meters with solar initiatives are considered in buildings owned by the government. The study confirmed that no monitoring systems or significant technological solutions are implemented in buildings that are not owned by government. Changing behaviour of people is key and in instances very practical and relatively easier to implement.

8.4. Recommendations

8.4.1. Barriers and opportunities

The study revealed that the greatest opportunity presented to support sustainable development through sustainable refurbishment of existing buildings is that of a project type as per the Kopanong Precinct Project, the PPP model. Buildings that are owned and occupied currently by the government perform in-between the upper and lower success margins of sustainable refurbishment. The greatest barrier to sustainable refurbishment of existing buildings is highlighted in a case where government departments lease in a building that is not owned by the government. As indicated by the study, this scenario is not easily avoidable currently but will be eradicated or significantly minimised if the Kopanong Precinct Project is successfully implemented. A recommendation in this instance would therefore be for all stakeholders to fully support the implementation of the Kopanong Precinct Project.

An opportunity emerges from the continuous references to the successes at the healthcare and education sectors. These successes should be detailed, adopted and adapted as required for the office sector.

One of the barriers identified was the inability to effect change at the external façade of the buildings regarding both thermal and acoustic performance. Linked to this, there were no common specific reference to thermal and acoustic insulation which are both significant factors to consider in relation to occupant comfort and well-being as raised in this study. This should be explored further with stakeholders and tested with future projects. A firm recommendation would be to contact experts in the field of implementing multi-comfort building solutions designed to create great living spaces and improve the daily lives of building occupants everywhere.

Regarding longevity of products, lifecycle costs and life cycle assessments, these can be considered as both barriers and opportunities. These life cycle assessments and environmental product declarations are generally not readily available locally but the opportunity is that market demand will prompt building product manufacturers to facilitate their development. Select local manufacturers have already begun this process of product transparency and awareness on environmental, economic and social impacts.

A firm recommendation to further strengthen the impact of implementing sustainable solutions would be to measure occupant productivity post refurbishment. The research indicates that reduced utility bills demonstrating cost savings are a significant notable improvement. One of the current project objectives highlighted in this study is to establish if the improved working environment leads to or effects a more productive workforce.

Inefficiencies cannot be locked in by not considering future thinking and planning. The study revealed that there may be an opportunity to improve or change building occupant behaviour regarding; water consumption, lighting usage, energy usage and recycling. Through awareness and education as these may be relatively easier to implement rather than installing new systems or solutions to achieve similar results.

8.5. Directions for future research

A few directions for future research emerge from the recommendations discussed in the previous sub chapter.

The successes at the health and education sectors that have been highlighted through the semi-structured interviews, presents a tempting opportunity to investigate the interventions at these sectors at a macro and micro level and assess its adaptation to the challenges faced in the office sector.

The external facade of existing buildings has been identified as a building element that receives minimal attention in terms of any refurbishment actions yet this building element presents significant value in terms of improving thermal and acoustic comfort. Future research could be directed toward analysing the gap between the current and target states in relation to improving the performance of the existing building external façade. The aim could be linked to assessing the social, environmental and economic benefits gained from improving the performance of the external façade in comparison to the barriers that hinder the intervention taking place.

Life Cycle Assessments (LCA) and Environmental Product Declarations have been developed for construction products in various markets abroad since the early 1990's. Construction products manufacturer Saint-Gobain Isover was the first glasswool manufacturer in the world to carry out LCA more than 25 years ago. Today this business has more than 400 EPD's across the globe. International green building councils are recognising EPD's as part of their green

building certification schemes. LEED (Leadership in Energy and Environmental Design) is one such building rating system. LEED is also recognised as the most widely used building rating system in the world. Future research could be directed toward analysing the global trends related to sustainable refurbishment and life cycle assessment (and EPD) of products and systems and anticipating and preparing for its activation in the African context. This topic is linked to concepts including; circular economy, product transparency, skills development and job creation and these could be addresses in future research.

Future research could also include strengthening the impact of implementing sustainable solutions by measuring occupant productivity post refurbishment. One of the current project objectives highlighted in this study is to establish if the improved working environment leads to or effects a more productive workforce.

Inefficiencies cannot be locked in by not considering future thinking and planning. Future research could be directed toward improving or changing building occupant behaviour regarding; water consumption, lighting usage, energy usage and recycling and assessing its impacts on society, economy and environment. Through awareness and education as these may be relatively easier to implement rather than installing new systems or solutions to achieve similar results.

The study did not capture significant feedback on the effects of BIM and CIM on project delivery nor it being used or seen as a mechanism for facilitation of sustainable refurbishment of existing buildings. Further study into this field of BIM and the link with this study is recommended.

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10. Appendices

10.1. Appendix 1: Semi Structured interviews

1. Provide your view on refurbishing of existing buildings.
2. In this context, describe the current state of the refurbishment process from a sustainable development perspective.
 - a. Environmental
 - i. Energy, water, waste
 - b. Economic
 - c. Social
3. Please describe the manner in which the brief is developed
 - a. Requirements, drivers, stakeholders
4. What are the key areas for improvement (building) noted in the refurbishment process/strategy?
5. Generally, in this context are you able to meet the requirements of the brief?
6. What are the noted improvements in building performance?
7. *Comment: integration of social, economic and environmental factors into planning, implementation and decision-making*
8. *Comment: energy assessment and classification, identification of technological solutions for energy efficiency and the integration of renewal systems*
9. Discussion: case study

10.2. Appendix 2: UNABRIDGED - Cross case study analysis. Conclusions and recommendations

Conclusions

View on refurbishing of existing buildings.

Refurbishment of existing buildings is considered the most sustainable response when considered against other activities in the built environment. Promoting sustainable development and green building principles is still critical toward a more sustainable built environment. The government is committed to sustainable development and the green agenda and this is evident through the various programs, policy, pending legislation, dedicated teams and proposed major projects including the Kopanong Precinct project. A national norms and standards is required to facilitate this agenda.

Social concerns and impacts featured prominently as a driver for refurbishment projects through user dissatisfaction. Clients are more aware and demanding now compared to previous years regarding sustainable development and implementing sustainable solutions in both the public and private sectors.

From the three models contained in this study; leased buildings occupied but not owned by government, buildings occupied and owned by government and government owned buildings that are to be refurbished through a public private partnership model, the latter appears to be the most promising model.

There is a clear focus and priority on the healthcare and education sectors.

The current state of the refurbishment process from a sustainable development perspective.

In instances where government departments lease a building, the landlord drives the refurbishment and costs are included in the rentals.

The study revealed that government is committed to green initiatives and sustainable development. GDID employees aim to inform decisions at every opportunity present. This was revealed at the Pritchard Street case study. Mechanical, electrical and water systems are replaced with more efficient solutions where possible. The social awareness and efforts are raised and these are also maximised wherever possible.

Challenge areas raised include effecting change to existing facades as well as waste separation and efforts to divert waste from landfill related to both construction and operation waste.

Responses from the respondents revealed that longevity of products and systems is key and therefore life cycle costs and full life cycle product assessments should inform the decision making. One of the exposures of the research was that the defining feature of green building or sustainable development is systems thinking. These systems can be seen as the social, economic and environmental aspects.

The manner in which the brief is developed. Requirements, drivers, stakeholders

A review of the responses from respondents reveal that the brief is frequently initiated by departments undergoing expansion or reorganisation. It also emerged that the that the brief is developed on various interpretations of full life cycle refresh. Occupant dissatisfaction as well as compliance concerns are also drivers prompting the development of a design.

A review of the responses from respondents indicate that parliament should actively support and invest in sustainable development. Expiring leases are also a key indicator for refurbishment and often prompts the development of a brief. The development of the brief should receive input from all key stakeholders in order to achieve maximum benefits and results.

The research revealed that often the brief indicates what is to be delivered and not necessarily how, or the manner in which the objective should be met. This is the opportunity where sustainable solutions requiring sustainable decisions should be built into the brief. The brief should receive inputs from green technologies unit and other key stakeholders at the earliest opportunity in order to aim for maximum delivery on the project.

The key areas for improvement (building) noted in the refurbishment process/strategy

The study reveals that reductions in consumption of energy, waste and water were key areas for improvement. This is followed by water recycling initiatives. Typically, improving the performance of the external façade is one of the least prioritised items.

The feedback from the respondents indicate that all buildings that are amended should be improved from a performance perspective. The research has shown that a key area for improvement is functional availability equating to SLA's (Service Level Agreements). Space optimisation and functionality should be encouraged through incentivising departments to use space more efficiently.

Office space for government within the city centre is a key priority and parking spaces and allocation is also a challenge. There is a drive to promote occupancy of existing buildings in Johannesburg CBD. Fixing buildings will lead to fixing the city. The issue of waste in the city centre and waste generation from operation of buildings is also an area for improvement. The Kopanong Precinct project through a PPP model has a greater opportunity of holistically addressing social, environmental and economic sustainability impacts.

Meeting the requirements of the brief?

The study reveals that the response here was an overwhelming yes. Space, functionality and safety requirements were non-negotiable but waste separation and recycling initiatives are frequent challenge areas due to education, awareness and behaviour change.

One of the major issues raised was that social considerations are implemented and are key output measures. These including parking, access to public transport, access to local amenities within walking distances as well as access to parks and public spaces. The Green Technologies Unit are successful in meeting the requirements of the brief as they are viewed as a “plug-in” and “plug-out” service provider.

The noted improvements in building performance

This study reveals that spatial allocation and functionality as well as user satisfaction were cited as noted improvements by respondents. Positive user feedback has been received and occupants report improved levels of comfort at these case studies.

The research indicates that reduced utility bills that are demonstrating cost saving are a significant notable improvement. One of the aims highlighted in this study is to establish if the improved working environment leads or affects a more productive workforce. A review of the responses from respondents indicate that more often than not it is reduced consumption of energy, water and waste. A common response recorded from the respondents was noting the successes regarding smart meters delivered the expected results.

Comment: integration of social, economic and environmental factors into planning, implementation and decision-making

A review of responses from all respondents associated with the GDID referred to the Kopanong Precinct Project where the integration of social, economic and environmental factors would be integrated optimally into the design and development of the precinct. This project is the PPP model. One of the goals of this project is to consolidate government head office into a precinct, a tightly confined area and efficiently serviced zone. Key tactics will be effected at the Kopanong Precinct Project. This will include the latest feasible green technologies; carbon emissions reductions as well as water reduction strategies. Social strategies are also integral including interaction, collaboration, employment, skills and retail mechanisms.

The research reveals that the city is trying hard to improve the perception and conditions of the physical environment of the city. This include significant efforts to improve the user experience of the city. The integration of environmental and social factors is now almost standard at every project. Health and well-being addressed through the creating or allocation

of social spaces and platforms are also a driver for current design. Pause areas, collaboration spaces, reading and dining spaces are key areas on a typical commercial floor plan.

Comment: energy assessment and classification, identification of technological solutions for energy efficiency and the integration of renewal systems.

A review of responses from respondents indicated that energy assessment and classification has financial benefits based on recent projects. Low tech and low maintenance should also not be underestimated. BIM is becoming commonplace due to information attached for construction and operation benefits and efficiencies. There's also been the introduction or emergence of CIMS (city information modelling).

The study revealed that rooftop garden concept, rooftop solar initiatives as well as integration of smart meters with solar initiatives are considered in buildings owned by the government. Rainwater harvesting and diverting waste from landfill is also becoming more commonplace. The study confirmed that no monitoring systems or significant technological solutions are implemented in buildings that are not owned by government.

The feedback received highlighted that technological solutions are sometime used as a crutch. Changing behaviour of people is key and in instances very practical and relatively easier to implement.

The study revealed that much efforts are focussed and directed to health and education projects. Some examples include; water saving measures, efficient eco cisterns, aqua trip water saving, recycling waste water, bio-digesters at schools for cooking. Waste water treatment plants in schools and clinics and all boilers are being converted from coal to gas. Power generated on the weekend will be fed back into the grid at no cost to the local municipalities.

Recommendations

Barriers and opportunities

The study revealed that the greatest opportunity presented supporting sustainable development through sustainable refurbishment of existing buildings is that of a project type as per the Kopanong Precinct project, the PPP model. Buildings that are owned and occupied currently by the government perform in-between the upper and lower success margins of sustainable refurbishment as the study reveals. The greatest barrier to sustainable refurbishment of existing buildings is highlighted in a case where government departments lease in a building that is not owned by the government. This is a scenario that is not easily avoidable currently as the study indicates but will be eradicated or significantly minimised if the Kopanong Precinct Project is successfully implemented. A recommendation in this instance would therefore be for all stakeholders to fully support the implementation of the Kopanong Precinct Project.

An opportunity at buildings that are currently owned and occupied, is the fact that lease renewals and therefore refurbishment cycles are periodical and this means that these could be effectively planned for with sufficient time to engage all stakeholders for input and participation. This emerged from the interviews as key to the success of a project.

An opportunity emerges from the continuous references to the successes at the healthcare and education sectors. These successes should be detailed and adopted and adapted as required for the office sector.

An emphasis on the social facet of sustainability is an opportunity as identified by the research. User dissatisfaction and discomfort in spaces were raised throughout the semi-structured interviews. Increased user interaction and feedback regarding new projects is recommended.

Feedback from respondents indicate that the most basic design principles should be considered in all refurbishment projects with the intention to design responsibly considering people, planet and profit. One of the barriers identified was the inability to effect change at the external façade of the buildings regarding both thermal and acoustic performance. Linked to this, there was no common specific reference to thermal and acoustic insulation which are both significant factors to consider in relation to occupant comfort and well-being as raised in this study as an important consideration. This should be explored further with stakeholders and tested with future projects. A firm recommendation would be to contact experts in the field of implementing multi-comfort building solutions designed to create great living spaces and improve the daily lives of building occupants everywhere. Regarding longevity of products, lifecycle costs and life cycle assessments, these can be considered as both barriers and opportunities. These assessments and declarations are generally not readily available locally but the opportunity is that market demand will prompt building product manufacturers to facilitate the development of these. Select local manufacturers have

already begun this process of product transparency and awareness on environmental, economic and social impacts.

A recommendation and opportunity that the research revealed is to continue with the awareness and commitment from government stakeholders as this is currently demonstrating successes. Further active support and investment is required from parliament. Implementing the pending legislation regarding sustainable development of new buildings as well as sustainable refurbishment of the existing building stock is much required to ensure the required progress to meet carbon emission, energy and water reduction targets. A review of the responses from the respondents indicate no overwhelming or significant reference to many of the existing guidelines or policies regarding green building or sustainable development as discussed at chapter 5 in this study.

The study highlighted that a barrier identified was waste separation and recycling initiatives at both construction and operation stages. This was attributed to stakeholder awareness, education and behaviour changes. This area of waste separation and recycling was identified as more successful at both education and healthcare sectors. These successes should be detailed and adopted and adapted as required for the office sector.

There is an opportunity for the design brief to emphasis on how a product must be delivered and not necessarily what product must be delivered. This is the opportunity where sustainable solutions requiring sustainable decisions should be built into the brief. Stakeholders like those at The Green Technologies Unit should be engaged at the earliest of opportunities to ensure maximum output.

A firm recommendation to further strengthen the impact of implementing sustainable solutions would be to measure occupant productivity post refurbishment. The research indicates that reduced utility bills that are demonstrating cost saving are a significant notable improvement. One of the current project objectives highlighted in this study is to establish if the improved working environment leads to or effects a more productive workforce

Inefficiencies cannot be locked in by not considering future thinking and planning. The study revealed that there may be an opportunity to improve or change building occupant behaviour regarding; water consumption, lighting usage, energy usage, recycling and awareness and education as these may be relatively easier to implement rather than installing new systems or solutions to achieve similar results.

The study did not capture significant feedback on the effects of BIM and CIM on project delivery or it being used or seen as a mechanism for facilitation of sustainable refurbishment of existing buildings. A recommendation for further study into this field of BIM and the link with this study is made here.