

SUSTAINABLE HUMAN SETTLEMENT DEVELOPMENT: COST IMPLICATIONS OF GOING GREEN

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by

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DECLARATION

I declare that this dissertation is my own work. It is being submitted for the degree of Master of Science (MSc) at the University of the Free State. This dissertation has not been submitted before, for any degree or examination at any other university.



.....
Cameron Greyling

31 January 2017

DEDICATION

I dedicate this dissertation to God Almighty. Without Him, none of this would have been possible.

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ABSTRACT

The South African government directs low income housing in the framework of sustainable development with clear guidelines (South Africa. Department of Human Settlements, National Housing Code: Part 3, 2009). However, the international shift towards “green” housing (WCED, 1987), may require a paradigm shift for developers and implementers. The financial cost of greening, cost of support, cost of effort, life cycle costs and the opportunity costs are being investigated. The various benefits, drivers, barriers and methods of green construction, with specific reference to sustainable human settlements, were sourced from literature. A study was conducted on the application thereof in the construction industry, to be able to understand and calculate the scope of going green and the methods currently applied in the construction industry. An exploratory survey informed the interview protocol. The main study involved two phases. Firstly, the analysis of two South African case studies, namely the Cosmo City development and the Savanna City development. Secondly, the conducting of face-to-face interviews with various sustainable human settlement development stakeholders in the Free State and Gauteng provinces. Key finding included a lack of knowledge, skills or experience regarding the cost and effective implementation of green construction practices and procedures related to sustainable human settlements, may have a negative influence on the construction industry’s reputation regarding green building. Developers, implementers and decision-makers may find information, from this study, regarding the cost of going “green” which includes building methods, materials and design of use in planning for sustainable human settlements. Knowledge of the possible green construction practices and procedures in the construction industry may be beneficial to improve the quality of life for housing beneficiaries. These practices are not necessarily more expensive.

Key words: Environmentally friendly construction, sustainable human settlements, cost of green construction.

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LIST OF ABBREVIATIONS

BNG	:	Breaking New Ground
BRE	:	Building Research Establishment
BREEAM	:	Building Research Establishment Environmental Assessment Method
CDS	:	Centre for Development Support
COGTA	:	Department of Governance and Traditional Affairs
CSF	:	Critical Success Factors
CSIR	:	Council for Scientific and Industrial Research
DFI	:	Development Finance Institutions
DHS	:	Department of Human Settlements
ECE	:	Economic Commission of Europe
EE	:	Embodied Energy
EEB	:	Energy-Efficient Building
EIA	:	Environmental Impact Assessment
ELM	:	Emfuleni Local Municipality
ESKOM	:	Electricity Supply Commission
FLISP	:	Finance linked individual subsidy programme
GBCSA	:	Green Building Council of South Africa
GDP	:	Gross Domestic Profit
GHGE	:	Green House Gas Emissions
HDA	:	Housing Development Agency
HIFSA	:	Housing Impact Fund of South Africa
HIV/AIDS	:	Human Immunodeficiency Virus/ Acquired Immune Deficiency Syndrome
HVAC	:	Heating, Ventilation and Air-Conditioning
IDP	:	Integrated Development Plan
IIED	:	International Institute for Environment and Development
IMCSA	:	International Marketing Council of South Africa
IRDP	:	Integrated rural Development Plan
IUCN	:	International Union for the Conservation of Nature
LCA	:	Life Cycle Assessment
LCCA	:	Life Cycle Cost Analysis

LGTAS	:	Local Government Turnaround Strategy
MDG	:	Millennium Development Goals
MLM	:	Midvaal Local Municipality
MTSF	:	Medium Term Strategic Framework
NASHO	:	National Social Housing Organization
NGO	:	Non-governmental Organization
NHBRC	:	National Home Builders Registration Council
NHFC	:	National Housing Finance Corporation
NURCHA	:	National Urban and Reconstruction Agency
OECD	:	Organisation for Economic Co-operation and Development
PPP	:	Public Private Partnership
RDP	:	Reconstruction and Development Programme
RHLF	:	Rural Housing Loan Fund
SANS	:	South African National Standards
SBCI	:	Sustainable Buildings and Climate Initiative
SDM	:	Sedibeng District Municipality
SHF	:	Social Housing Foundation
SHI	:	Social Housing Institutions
SHS	:	Sustainable Human Settlement
SRS	:	Simple Random Selection
UN	:	United Nations
UNEP	:	United Nations Environment Programme
US	:	United States
USGBC	:	United States Green Building Council
VAT	:	Value Added Tax
WBCSD	:	World Business Council for Sustainable Development
WCED	:	World Commission of Environment and Development
WGBC	:	World Green Building Council

LIST OF DEFINITIONS

Cost: An amount that has to be paid or spent to buy or obtain something. The effort, loss, or sacrifice necessary to achieve or obtain something (Merriam Webster Dictionary, 2016a: Online)

Green Building: A Building that is energy-efficient and environmentally responsible (WGBC, 2014: Online)

Green Construction: Integrated building practices that significantly reduce the environmental footprint of a building in comparison to standard practices (Fischer, 2010: 3)

Human Settlement: The totality of the human community, whether a city, town or village, with all the social, material, organizational, spiritual and cultural elements that sustain it (UN General Assembly, 1976: 12)

Sustainability: Transforming our ways of living to maximize the chances that environmental and social conditions will indefinitely support human security, well-being and health (McMichael, Butler, & Folke, 2003)

Sustainable Construction: The creation and responsible management of a healthy built environment, based on resource efficient and ecological principles (Bourdeau, 1999: 41)

Sustainable Development: Development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs (WCED, 1987)

Sustainable Human Settlements: Settlements that make efficient use of resources within the carrying capacity of ecosystems and takes into account the precautionary principle approach (United Nations Conference on Human Settlements, 1996)

CHAPTER 1: ORIENTATION OF THE STUDY

1.1 FORMULATION OF THE RESEARCH PROBLEM

South Africa still faces post-1994 challenges regarding housing delivery, housing demands and integrated sustainable development (Sutherland, Hordijk & Scott, 2016). Central to this is the need for good-quality housing for poor households earning less than R3,500.00 per month and who experience social and economic segregation (South Africa: National Housing Code, 2009). Affordability, limited resources and growing demands for sustainable human settlements require a re-thinking of strategies for housing the poor. In order to effectively address the developmental goals of the South African government, there is a need for an integrated approach of housing restructuring, sustainable technologies and economic and social integration (South African Cities Network, 2014). According to President Jacob Zuma, the provision of housing within sustainable, integrated settlements, is a critical pillar of the country's growth and development strategy (Times LIVE, 2010: Online).

Accordingly, integrated systems and sustainable processes need to be considered throughout the project life cycle. In addition to design requirements, acquisition of land and infrastructure places a monetary burden on government. According to the Centre for Development Support (CDS, 2010), the South African Government faces several challenges, such as affordability, well-located and integrated land for low-cost housing, underwhelming national policy implementation, growing demand for housing subsidies and an apparent lack of implementation capacity. It can be deduced that housing in itself requires money, capacity, land, infrastructure and visionaries for sustainable designs, systems and materials, which puts an additional burden on taxpayers. There are currently, as at 30 September 2015, less than 5 million registered tax payers in South Africa and 16,9 million people receiving welfare payments (Bryer, 2015: Online). This is indicative of the current human settlement development scenario not being sustainable in the long run. There is a need to revisit the extant housing provision strategy.

Questions concerning the sustainability and effectiveness of the extant housing provision strategy have arisen as a result of the increasing demand for affordable housing by majority of South African citizens. In 2012, it was reported that the South African government had built almost 3 million low-cost houses since 1996 and forecast that a further 3 million were targeted by 2025 (British High Commission, Pretoria, 2012: 1). Statistics indicate that in 2010, after sixteen years of democracy, South Africa still faced a massive housing backlog of approximately 2.1 million units (Business Day, 2010). In 2011, according to Census (2011: 56), 21.5% of all South African houses were still traditionally or informally constructed. Figures suggest that huge accumulated amounts are budgeted annually for housing delivery in South Africa and the budgeted amounts are not currently or for the foreseeable future going to show a decline. Furthermore, the International Marketing Council of South Africa (IMCSA) (2012) posits that the government inherited a critical housing shortage with a housing backlog of 2,202,519 in 1994.

Knight (2001: Online) suggests that the housing backlog in South Africa is aggravated by a high unemployment ratio, which currently stands at 25%, according to Statistics South Africa (StatsSA, 2014). In addition, Eglin (2010: Online) suggests that the South African housing backlog increased from 1994 to 2004, due to national population growth, trends of urbanization and inadequate delivery to address the historical backlog. If forecasts are considered, it seems as if the number of houses to be delivered in the next nine years, up to 2025, is consistently high and seems to not be showing a decrease, even with houses being consistently delivered. With a subsidy amount of approximately R160,573.00 in 2016 for a subsidised house (Western Cape Government, 2016: Online), this will result in large government expenditure in terms of housing delivery for at least the next nine years. The Financial and Fiscal Chairperson, Bongani Khumalo, estimated net current value of R800 billion (eNCA, 2013: Online) is required to eradicate the housing backlog by 2020. Financially sustainable housing delivery, requires the South African government to seriously investigate the transformation of the built environment (Thornhill, 2012).

Apart from the challenge of the housing-provision strategy, poor-quality workmanship increases the financial burden on government. South Africa's former minister of

Human Settlements, Mr Tokyo Sexwale (2012), stated that about 40,000 Reconstruction and Development Programme (RDP) houses would have to be demolished due to poor workmanship. Sexwale (2012) continued to outline the prediction that approximately 10% of the budget would be forfeited to rebuild those houses (South Africa Info, 2010). Sexwale (2012) estimated the cost of 'poor workmanship' at about R1,3 billion, which is required to rebuild inferiorly constructed houses under the government's housing programmes (Fin24, 2010). Such accumulated budgetary implications seem to be the result of poor planning, monitoring and control.

In addition to financial constraints in developing human settlements in a sustainable manner, OECD (2013) suggest that Africa's economic problems have also exacerbated the stress on its natural resource base. Energy production and use have been linked to environmental problems such as pollution, loss of water resources, loss of habitat and biodiversity, soil erosion, deforestation, solid waste, atmospheric pollution and coastal erosion (Alarcon, 1998). The causes of these environmental problems include among others, high population growth, lack of policies, ineffective regulations, lack of management and organization and a lack of awareness (Hardoy, Mitlin and Satterthwaite, 2013: 87). Simply put, the processes involved in the delivery of this housing stock will inadvertently impact negatively on the environment as a result of the series of anthropogenic activities involved.

The built environment, including the housing sector, is a major contributor to environmental degradation, especially as it consumes about 40% of the world's energy and materials, 55% of wood cut for non-fuel use and 12.2% of total water used (Hoffman & Henn, 2008, United States Green Building Council Research Committee, 2008, UNEP SBCI, 2009; Roodman & Lessen, 1995). Xue (2012: 20) suggests that the major housing-related environmental impacts can be grouped into three categories: material consumption, energy consumption and land-use associated impacts. Guan (2009: 1-2) reinforces this classification by stating that the impact of buildings on the process of global warming is through three routes, namely: energy consumption for building operations, embodied energy in building material and construction, and finally, building-related refrigerants.

Legislation and building challenges, according to Hakkinen and Belloni (2011: 240), include barriers to sustainable building, non-integrated design, lack of knowledge and awareness of sustainable building technologies, insufficient marketing processes, inappropriate procurement and value chain processes. Degreve (1998) also promotes different approaches that may be followed, which includes voluntary, legislative, economic and fiscal measures, towards sustainable environmental standards.

The above suggests that economic, social and environmental challenges, demand a reform of built environment practices. Sustainable and environmentally friendly practices such as going green, besides offering an improved quality of life to the poor, often consist of value-adding activities which decrease the burden on the earth's resources in the long term (Lambin, 2014). The current South African housing provision strategy, although seemingly equitable, affordable and well-structured, may not be sustainable. The delivery process needs transformation. With the South African government low-cost housing framework of sustainable development, clear guidelines (South Africa, Department of Human Settlements: 2009), for green construction should be enforced.

The international paradigm shift towards green housing (WCED, 1987) may offer the potential of transforming design, material process and affordability to sectoral stakeholders within South Africa. However, information concerning the process and cost implications of adhering to or implementing the tenets of green housing in the South African low-cost housing context, remains an area that has seemingly been under-researched. This study is necessitated by the belief that studying these factors extensively may yield useful results which would contribute to the evolution of a more sustainable approach to low-cost housing provision in South Africa.

1.2 STATEMENT OF RESEARCH QUESTION

The main research question is: How can the delivery of integrated human settlement developments in South Africa be sustainable in terms of costing?

The following sub-research questions are identified:

- What are the factors affecting the delivery of sustainable human settlement developments in South Africa?
- What are the perceptions of going green in the human settlement sector?
- How do the prevailing perceptions affect the execution of human settlement developments?
- How should the cost concerns of going green in the human settlement sector best be dealt with in South Africa?

1.3 AIM AND OBJECTIVES OF THE STUDY

1.3.1 Aim

This research is aimed at determining how the delivery of human settlements in South Africa can be enhanced to become more sustainable in terms of costing.

1.3.2 Objectives

To realise the aim, the objectives of the research are to:

- Establish the key factors affecting the delivery of sustainable human settlements in South Africa
- Determine the perceptions of going green in the human settlement sector
- Examine how perceptions of going green influence human settlement projects
- Recommend how the delivery of human settlements can become more sustainable in terms of costing.

1.4 SIGNIFICANCE OF THE STUDY

It is expected that the outcome of this study will be a valuable source of information for construction industry stakeholders, especially developers and consultants, in promoting 'greening' in the industry. Developers, implementers and decision-makers may find information regarding the cost of 'green' building and construction including

methods, materials and design useful for planning environmentally friendly human settlements.

Promoting and delivering green housing is in line with international targets (such as the Millennium Development Goals and the current Sustainable Development Goals initiatives of the United Nations) for addressing the issues of global warming, climate change and carbon footprint challenges (Dora, Haine, Balbus, Fletcher, Adair-Rohani, Alabaster, Hossain, de Onis, Branc & Neira, 2015). The identification of costs involved in environmentally friendly low-cost housing, may provide a foundation for guidelines for industry role-players to improve implementation frequency and success. Knowledge of possible environmentally friendly construction practices and procedures in the construction industry may also be beneficial to improve the living standards of housing consumers which is not necessarily at a higher cost.

The motivation for choosing this research topic, is based on the necessity of improving Sustainable Human Settlement Development delivery in South Africa in order to meet the current housing demands. Other reasons include:

- The lack of Sustainable Human Settlement Development case study research conducted in South Africa.
- To provide measures that may assist role-players to ensure effective implementation and delivery of Sustainable Human Settlement Developments.

1.5 SCOPE OF THE STUDY

The empirical study is limited to two case studies in Gauteng, South Africa in order to better understand green building practices applicable in the South African low-income housing scenario. The research focuses on low-income housing developments due to the large number of such projects undertaken. The case studies include an in-depth analysis of the Cosmo City development in Johannesburg and Savanna City development in Midvaal, Gauteng. To support the case study findings, perceptions of role players in the sector were also sought on a

range of issues. However, only construction role-players in the Free State and Gauteng provinces were sought. The following delimitations apply to the study:

- Interviews were conducted with construction industry stakeholders involved in the delivery of sustainable human settlement developments.

1.6 ASSUMPTIONS

Assumptions are so basic that without them, the research problem itself would not exist (Leedy & Ormrod, 2010: 59). The following assumptions are therefore made regarding this study:

- Sustainable human settlements refer to low-income housing developments near urban areas
- Green building costs refer to a wider range of costs involved, than simply direct and indirect costs involved in the construction of housing units and related infrastructure.

1.7 RESEARCH METHODOLOGY OUTLINE

This study relies on a literature review followed by an empirical study. The researcher has adopted a qualitative research approach and selected a phenomenology design for the study. Data were collected through a combination of interviews and document analysis. The interviews serve as the primary data of this study and the document content analysis serves as the secondary data of this study. Interviews were conducted with a variety of industry stakeholders, including government officials, developers, consultants and contractors. A purposive sampling method was used and interviewees were selected based on their direct or indirect (through previous research conducted) involvement in sustainable human settlement development/projects. The expert interviews provided the researcher with the insight into the nature of data to seek for during the document analysis. A detailed discussion of the chosen methodology is provided in Chapter 3.

1.8 ORGANIZATION OF CHAPTERS

The study is presented in five chapters, as follows:

Chapter 1: Orientation of the Study

Chapter 1 provides the basis for the study. It identifies the research problem, the significance of the research, formulates the research questions and gives the purpose and scope of the study.

Chapter 2: Sustainable Human Settlement and the Cost Challenge

Chapter 2 examines the literature regarding the international sustainability debate, clarifies some terminologies, describes challenges and discusses the interpretation of what sustainable human settlements entail. The chapter also examines different international and national strategies towards creating sustainable human settlements and the various role-players involved in the process. This chapter further explores the concept of environmental-friendly building concerning both materials used and construction practices. In addition, the chapter discusses issues pertaining to various cost centres and the implications of such cost centres in the delivery or implementation of sustainable low income housing or sustainable human settlements.

Chapter 3: Research Methodology

Chapter 3 describes and justifies the methodology chosen for the empirical study.

Chapter 4: Analysis and Discussion of Results

Chapter 4 presents and discusses the results of the empirical study that was undertaken according to the methodology set out in Chapter 3.

Chapter 5: Summary, Conclusions and Recommendations

Chapter 5 draws the conclusions and provides recommendations for further policy and other actions government and other role-players will have to take in order to develop sustainable human settlements in South Africa.

1.9 CHAPTER SUMMARY

This chapter has provided an overview of the phenomenon under review, highlighted the problem, research question, propositions, aim and objectives, whilst providing the outline of the subsequent sections of the study. The study is relevant and may provide valuable insights into the current sustainable human settlement delivery strategy in South Africa.

CHAPTER 2: SUSTAINABLE HUMAN SETTLEMENT AND THE COST CHALLENGE

2.1 INTRODUCTION

This chapter investigates the housing-provision strategy in South Africa with special reference to sustainable human settlement development. International and national attempts and approaches in delivering low-income (affordable) housing are investigated against acceptable sustainability criteria. The potential for going green as an attempted move towards sustainable practices will be investigated within the sustainable and green framework.

2.2 THE CONCEPT OF SUSTAINABLE HUMAN SETTLEMENTS

Central to sustainable development are nature and humans. Sustainability can be defined as the ability to support, keep alive and/or to keep going. Sustainability allows the continued existence of humans. Due to ever-changing external and internal environments, this cannot be seen as a fixed state, but one of dynamic balance which requires the continuous adaptation to changing conditions (CSIR, 2002). According to the Bond and Morrison-Saunders (2013), weak sustainability exists where different kinds of capital are fully interchangeable and that natural capital can therefore be used till exhausted as long as it is converted into manufactured capital of equal value. Contrary to this, strong sustainability is the idea that there are certain functions that the environment performs which are essential for the welfare and survival of the human species which cannot be duplicated by humans. The environment's inability to perform these functions, including the ozone layer, carbon and hydrological cycle, would endanger human survival.

The main differences between weak and strong sustainability are summarized in Figure 1.

Main differences between weak and strong sustainability		
	Strong sustainability	Weak sustainability
Key idea	The substitutability of natural capital by other types of capital is severely limited	Natural capital and other types of capitals (manufactured etc.) are perfectly substitutable
Consequences	Certain human actions can entail irreversible consequences	Technological innovation and monetary compensation for environmental degradation
Sustainability issue	Conserving the irreplaceable « stocks » of critical natural capital for the sake of future generation	The total value of the aggregate stock of capital should be at least maintained or ideally increased for future generation
Key concept	Critical natural capital	Optimal allocation of scarce resources
Definition of thresholds and environmental norms	Scientific knowledge as input for public deliberation (procedural rationality)	Technic/scientific approach for determining thresholds and norms (instrumental rationality)

Figure 1: Main differences between weak and strong sustainability

Source: Adapted from Mancebo (2013)

2.2.1 The dimensions of sustainable development

According to the United Nations, the essential needs of the world's poor and thereafter the future should be prioritized (CSIR, 2002). The concept of sustainable development was popularized by the Brundtland report which defined it as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987:45). Winkler (2006) suggests that sustainable development in its simplest form is "development which lasts". The Brundtland Report highlights two fundamental aspects of sustainability: the problem of environmental degradation relating to economic growth, and growth to alleviate poverty (IUCN, 2006). The Rio Declaration (United Nations, 1992) states that: "human beings are at the centre of concern for development". This is also captured by Boulanger (2008), who suggests that the definition of sustainable development (WCED) clearly refers to human beings and their well-being. Yet, as regards indicators, Agenda 21 (United Nations, 1992) refers only to systems.

Sustainable development commonly includes economic, social and environmental dimensions (Holden, 2008). Economic factors strive toward fair and equitable access

to resources in order for people to achieve long-lasting livelihoods and to establish economically viable businesses. Social factors strive to support fair and just societies that promote human development. Environmental factors aim to maintain a balance between protecting the physical environment and using resources in order for the earth to continue to support an acceptable quality of life for all people.

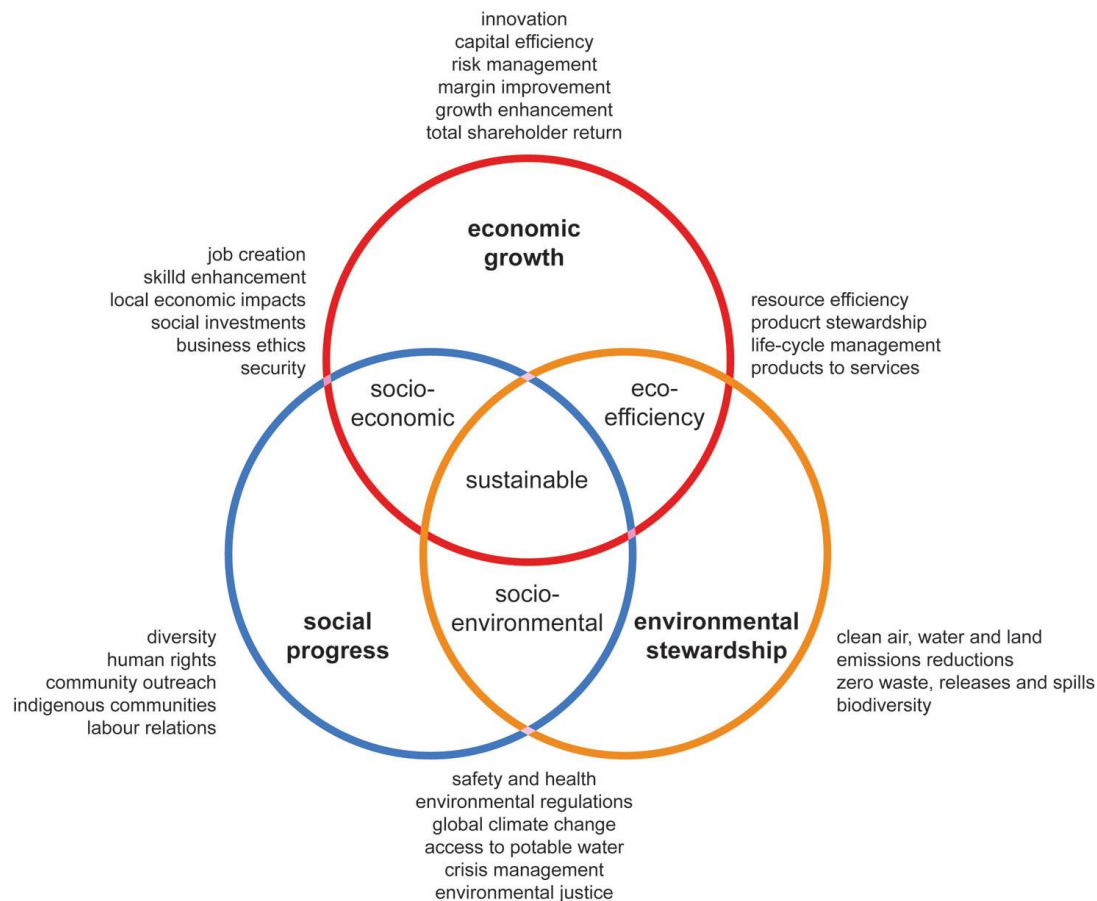


Figure 2: Dimensions of sustainable development

Source: Render (2009: 9)

Figure 2 captures the three dimensions of sustainable development as inter-dependent and collectively required for sustainability. It is evident that sustainability and environment relate to nature with a social and economic implication. If one investigates the potential of building green as an approach towards sustainable construction, it will socially add to a better livelihood. Economically the design and construction of green housing would require a capital investment. Boulanger (2008) suggests that only the economic branch as illustrated in Figure 2 is further developed, with two constituting dimensions, performance and resilience. Performance is evaluated by two indicators, Gross Domestic Product (GDP) and

Productivity. Resilience also gives rise to two dimensions, diversity and innovation, which are evaluated by the Entropy Index and Research and Development expenditure respectively (Boulanger, 2008).

To create a common understanding of what is meant by green, the approach of green is adopted from the Green Building Council of South Africa (GBCSA, 2013: Online). “Building green is an opportunity to use resources efficiently and address climate change while creating healthier and more productive environments for people to live and work in”. These might include several aspects of management: indoor environment quality, energy, water materials, land use ecology, emissions and innovation. Therefore, when reference is made to green, it should be viewed as an effort towards sustainable construction.

Sustainable development has been debated extensively by various experts over several years. Some of these arguments are shared in the next few paragraphs. These paragraphs show that there is currently no clear indication that the benefits outweigh the costs.

Hoffman and Henn (2008: 14) argues that many people see economic competitiveness and environmental protection as mutually exclusive and opposed. Similarly, Friedman (2007) argues that this is a false dichotomy and states that the interest of economy and competitiveness are tightly bound in issues relating to energy efficiency, particularly in the building sector. Meins, Wallbaum, Hardziewski and Feige (2010) provides measures for enhancing the number of sustainable buildings, either new or existing, including:

- The influence on housing demand, service zones, industrial areas and infrastructure
- Supply of construction products
- Changed management of existing buildings
- Stakeholder behavioural change and understanding the socio-cultural context (Meins *et al.*, 2010).

The CSIR (2002) furthermore determines that sustainability of a settlement depends on the interaction of four patterns namely:

- Physical structure as the placement of the settlement within the natural environment and therefore responding to the topography, the spatial relationship between the different parts of the city and the form of the built environment
- Patterns which are formed by the way the settlement uses its resources and is described by the infrastructure and the services provided;
- Social patterns of how people live, learn and work in, and relate to their settlement and the opportunities provided by the settlement for meeting these social needs
- Operational patterns as the functioning and management of human settlements.

Boulanger (2008) determines four major reference classes as the sustainable settlement domains, namely: socio-natural sectors (or systems), resources, people and standards. According to Boulanger (2008) only the norms-based approach can be considered as complete as it is informative on development as well as sustainability. Hall and Pfeiffer (2013) describe seven essential dimensions to a sustainable city, which include the following; urban economy providing work and wealth, urban society with social coherence and solidarity, urban shelter providing decent and affordable housing for all, urban environment with stable ecosystems, urban access through resource conserving mobility, urban life and urban democracy through an empowered citizenry.

The literature review so far, reveals that not only do the economic, social and environmental factors impact on sustainable development, but the demand for housing, socio-cultural factors; socio-economic cohesion, patterns, infrastructure, services and management.

2.2.2 Agendas for sustainable development

There are two agendas concerning sustainable settlement development. Firstly, the green agenda (Pugh, 2013), which focuses on reducing the impact of urban-based production, consumption, waste generation on natural resources and ecosystems and on the world's life support systems. Secondly, the brown agenda, which emphasizes the need to reduce the environmental threats to health that arise from poor sanitary conditions, crowding, inadequate water provision, hazardous air and water pollution and local accumulations of solid waste (Pugh, 2013). In the South African context, with high service delivery demands especially for the poor, the interaction between the green and brown agendas is further complicated (CSIR, 2002: 11). To drive the green and brown agenda, changes in human settlement development greening may need to be included.

2.2.3 Benefits and drivers of sustainable human settlements and green construction

i) Benefits of sustainable human settlements

Sustainable design and construction should be reviewed in terms of economic, social and environmental benefits. Ahn *et al.*, (2013: 36) identify several benefits for each of the stated categories as summarized in Table 1.

Table 1: Benefits of sustainability in human settlements

Economic	Social	Environmental
<ul style="list-style-type: none">▪ improved economic growth▪ reduced energy consumption and cost▪ increased real income▪ improved productivity▪ decreasing infrastructure costs▪ decreased environmental damage costs	<ul style="list-style-type: none">▪ improved quality of life▪ alleviating poverty▪ satisfying human needs▪ cultural sensitivity▪ optimized social benefits▪ comfort and well-being▪ improved health▪ inter-generational equity▪ minimized cultural disruption	<ul style="list-style-type: none">▪ air protection▪ water and land ecosystems▪ conserved natural resources▪ preserved animal species and genetic diversity▪ protected biosphere▪ renewable energy usage▪ minimized waste

<ul style="list-style-type: none"> ▪ reduced water consumption and costs ▪ decreased health costs ▪ decreased absenteeism in organizations ▪ improved return on investments 	<ul style="list-style-type: none"> ▪ education services ▪ harmony among humanity and nature promoted ▪ social and cultural capital realised ▪ multi-disciplinary communities 	<ul style="list-style-type: none"> production or disposal ▪ minimized CO₂ emissions and other pollutants ▪ maintaining essential ecological processes and life support systems ▪ active recycling ▪ integrity of the environment ▪ preventing global warming
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Source: Adapted from Ahn, *et al.* (2013)

Table 1 shows benefits for sustainable practices. The literature indicates that there are documented guidelines for sustainable human settlements, buildings, patterns and cities. If potential barriers (as discussed in paragraph 2.5 on p. 28), drivers and benefits of green construction for low-cost housing in South Africa are analysed, the all-inclusive cost of going green could be determined. The next paragraph contextualizes a framework for the green building.

ii) Benefits of green construction

Hoffman and Henn (2008: 7) states that economic benefits for going green go beyond capital costs and that advocates for green building also justify green building on the operating cost reductions in water, waste water and energy expenditure (hard cost benefits), as well as improved performance of building occupants (soft cost benefits). Promotion and implementation of green building practices within a community can generate new economic development opportunities. These opportunities can take a variety of forms, including new business development to meet the demand for green products and services, resource-efficiency improvement programs that enable existing businesses to lower operating costs, development of environmentally oriented business districts and job training related to new green businesses and products (Public Technology Inc., 1996: 20). According to Lipu, Jamal and Karim, (2013: 186) the benefits of green buildings include capital cost savings, better performance and operational cost savings, reduced construction time schedule, improved marketability and enhanced value, higher future value of property, reduced advertising costs and reduced liability and risk.

iii) Drivers of sustainable human settlements

The various drivers of sustainable human settlements, as recorded by Hakkinen and Belloni (2011: 240), are summarized in Table 2 below.

Table 2: Drivers of sustainable human settlements

Economic	Social	Environmental
<ul style="list-style-type: none"> ▪ beneficial operating costs of sustainable buildings ▪ long-term benefits for the national economy, due to reduced emissions 	<ul style="list-style-type: none"> ▪ improved well-being and productivity of occupants due to improved building performance 	<ul style="list-style-type: none"> ▪ use of natural resources

Source: Adapted from Hakkinen and Belloni (2011: 240)

Du Plessis (2012) identifies six human drivers of ecosystem change, including human induced physical, chemical and biological barriers, demographic drivers, economic drivers, scientific and technological drivers, cultural and religious drivers and socio-political drivers. Du Plessis (2012) continues to emphasize that the most change is needed in the drivers of culture and religion and socio-political.

In an attempt to directly link sustainability and green building, Table 3 summarizes the economic, social and environmental drivers of green building. According to the United States Environmental Protection Agency (2012: Online) when viewed in the context of sustainability, potential benefits of green building can include environmental, economic and social benefits.

Table 3: Drivers of green building

Economic	Social	Environmental
<ul style="list-style-type: none"> ▪ reduced operating costs ▪ creation, expansion and shaping of markets for green products and services ▪ improved occupant productivity 	<ul style="list-style-type: none"> ▪ enhanced occupant comfort and health ▪ heightened aesthetic qualities ▪ minimization of strain exerted on local infrastructure 	<ul style="list-style-type: none"> ▪ enhancement and protection of biodiversity and ecosystems ▪ improved air and water quality ▪ reduction of waste streams ▪ conservation and

▪ optimization of the buildings' life cycle economic performance	▪ improved overall quality of life	restoration of natural resources
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Source: Adapted from Ahn, Pearce, Wang & Wang (2013:35-45)

Comparing Table 2 and Table 3, the conclusion could be drawn that the benefits of green construction exceeds social, economic and environmental expectations. It could be concluded that green construction is a sustainable way of improving the quality of lives of people without compromising nature, increase social cohesion and is economically viable in the long term. To be able to successfully promote going green international and national, best practices, possibly including a comprehensive approach, innovative partnerships and community involvement, should be considered.

2.3 SUSTAINABLE HUMAN SETTLEMENTS IN AN EMERGING ECONOMY

2.3.1 Policy Framework for Sustainable Human Settlement Development

The main policies that have shaped the sustainable human settlement development environment internationally, since 1987, are explored in this section. The WCED Brundtland Report in 1987 (WCED, 1987) produced the report entitled 'Our Common Future' and produced a widespread and politically acceptable definition of sustainable development as "development that meets the need of the present without compromising the ability of future generations to meet their own needs". The creation of the Rio Declaration, Agenda 21 (United Nations, 1992) and framework conventions on desertification, biodiversity and climate change were produced at the 1992 UN Conference on Environment and Development (Rio Earth Summit). The Habitat Agenda was produced in 1996 during the UN Conference on Human Settlements (United Nations Conference on Human Settlements, 1996) and two major themes were highlighted: adequate shelter for all and sustainable human settlements development.

2.3.2 International Strategies

An Energy Efficient Building (EEB) study performed by the WBCSD (2009: 6) modelled three scenarios for the world's response to the climate challenge in buildings. The scenarios are as follows: complacency and inaction leading to a failure to tackle climate change, inadequate action resulting in only incremental improvements in energy efficiency and a substantial failure to curb climate impacts and finally, a coordinated intensive action that transforms the building sector and contributes proportionally to solving climate change.

The WBCSD (2009: 8-9) compiled a set of recommendations that outline the necessary steps to substantially reduce energy consumption and resulting carbon emissions; strengthen codes and labelling for increased transparency, incentivize energy efficient investments, encourage integrated design approached and innovations, develop and use advanced technology to enable energy-saving behaviours, develop workforce capacity for energy saving and mobilize an energy aware culture. Figure 3 illustrates the above recommendations.

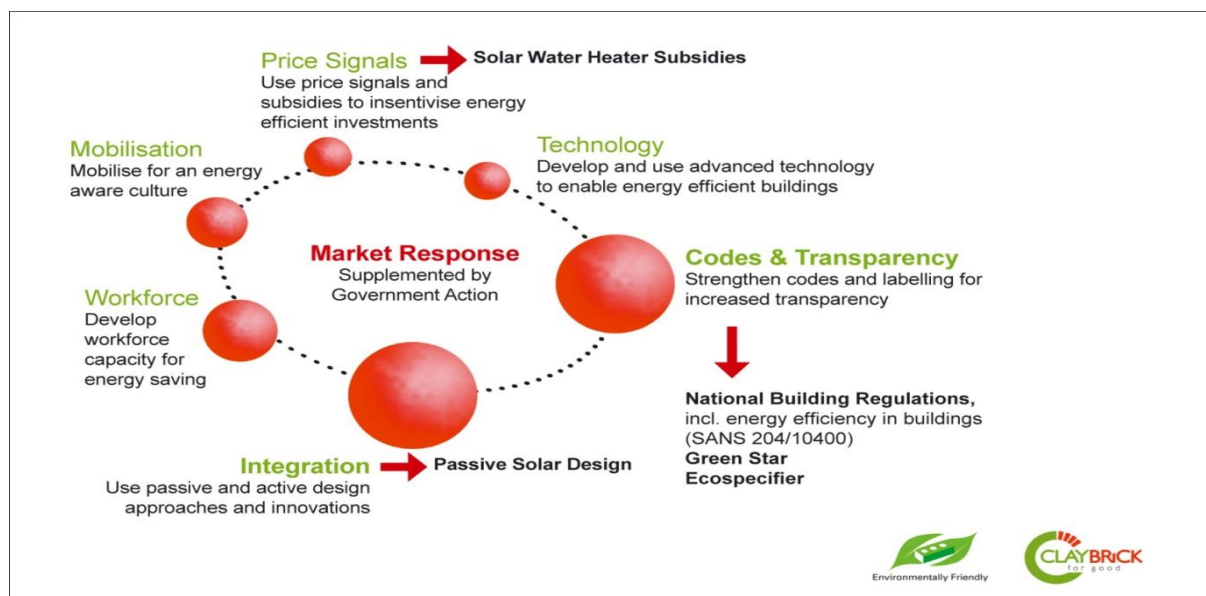


Figure 3: Mutually supportive recommendations

Source: WBCSD (2009: 52)

2.4 SUSTAINABLE HUMAN SETTLEMENTS DEVELOPMENT IN SOUTH AFRICA

2.4.1 Role-players in Sustainable Human Settlement Development

Various national role-players shape the South African sustainable human settlement environment. The main facilitator for housing delivery is the Department of Cooperative Governance and Traditional Leaders (COGTA, 2014). The three tiers of government (National, Provincial and Local), specifically the Department of Human Settlements, are, however, constitutionally mandated to provide decent housing, particularly for the poor (South Africa: National Housing Code, 2009). Apart from the private sector, investors, designers, developers and regulators, an attempt is made to list major role- players involved in housing the poor. National Government is expected to create an enabling environment for subsidized housing that includes social or gap housing (Social Housing Policy, 2005: 25). The development of a policy, legislation and a regulatory framework is a government function (Social Housing Policy, 2005: 25). Provincial governments should ensure fairness, equity and compliance with national and provincial norms and standards. They are also responsible for consumer protection. The Provincial governments are responsible for providing provincial legislation, mediating conflicts and administering of project capital grant funding (Social Housing Policy, 2005: 25). Local government should facilitate housing whilst encouraging new developments and projects, provide access to land and infrastructure, assist social housing institutions and provide grant funding and access to bridging finance (Social Housing Policy, 2005: 26).

The National Housing Finance Corporation (NHFC) (NHFC, 2013: Online) formulated the following measurable and impactful drivers for the period between 2013 and 2017:

- Expand housing finance activities, through the effective provision of housing finance solutions, thus enabling low-to-middle income households to have choice renting or owning or incrementally building, to meet their housing needs

- Facilitate the increased and sustained lending by financial institutions to the affordable housing market
- Mobilize funding into the human settlement space, on a sustainable basis, in partnership with the broadest range of institutions
- Conduct the business activities of the NHFC in a manner that ensures the continued economic sustainability of the NHFC, whilst promoting lasting social, ethical and environmental development
- Provide robust, timely and relevant market research.

The National Association of Social Housing Organization (NASHO) is active in awareness campaigns and information dissemination capacity building, promotes networking and exchange of knowledge and best practices among members (NASHO, 2013: Online). Seemingly there is no shortage of networking structures.

The National Home Builders Registration Council (NHBRC) (NHBRC, 2013: Online) protects the interests of the housing consumers and enforces compliance to the regulated building industry standards. If green practices are adopted, the NHBRC will be instrumental in the enforcement of standards.

The Housing Development Agency (HDA) (HDA, 2013: Online) focuses on the identification, acquisition and development of well-located land and buildings whilst also providing project management support and housing development services. If a dedicated institution is targeted with land issues, this should not be an obstacle.

For financing a housing and related infrastructure project, the National Urban and Reconstruction Agency (NURCHA) (NURCHA, 2013: Online) was established.

The Rural Housing Loan Fund (RHLF, 2013: Online) targets improved basic living standards of low-income rural people through the provision of funding.

The GBCSA (2013: Online) provides the tools, training, knowledge, connections and networks to promote green building practices across the country. The GBCSA has developed the Green Star SA rating system and is the official certification body for Green Star SA projects.

With all the institutions established, it is evident that South Africa should be able to implement a green construction policy. From the above analysis, it also seems evident that funding for housing provisions strategies is available.

2.4.2 Policy framework for sustainable green building

The South African Housing Act (Act 107 of 1997) sets out functions of National, Provincial and Local spheres of government. The Minister and National Government have a principle policy-making role. The South African Housing Code (2009) contains all national housing policies, as amended by the Minister and is binding on all Provincial and Local spheres of Government. According to the National Housing Code (2009), several forms of housing subsidies exist. If conforming to certain criteria, individuals, emerging developers and groups could access different funding programme of which a few are listed below:

- People's Housing Process – Support for households who want to enhance the subsidy by building or organizing the building of their own homes.
- Rural Subsidies – Available to beneficiaries who only enjoy functional tenure rights to the land occupied. This subsidy is only done on a project basis and beneficiaries decide on how to use the subsidy.
- Consolidation Subsidies – Designed to afford beneficiaries of serviced stands, by the previous dispensation, the opportunity to acquire houses.
- Institutional Subsidies – Available to qualifying institutions to enable them to create affordable housing stock for persons qualifying for housing subsidies
- Individual Subsidies – Qualifying beneficiaries are provided access to housing subsidies to acquire improved residential properties, or to acquire a house building contract. This option is only available to beneficiaries with access to housing credit.
- Project Linked – Enables households to access a complete residential unit, which is developed within an approved project-linked housing subsidy project, for ownership by beneficiaries.
 - Farm residences – The scheme promotes ownership/rental for farm workers.

In addition, the Finance-linked Individual Subsidy Programme (FLISP) caters for households earning between R3,501.00 to R15,000.00 per month, who can then qualify for a subsidy on a sliding scale. The subsidy parameters are that the upper limit is R87,000.00 and the lower limit is R20,000.00 (South Africa: National Housing Code, 2009).

Government has previously (2012) introduced a R1 billion housing fund aimed at assisting home buyers who fall above the RDP housing bracket (earning between R3,500.00–R15,000.00). A subsidy amount up to R83,000.00 enables a buyer to obtain housing finance from an accredited bank (BuaNews, 2012: Online). This Social Housing Policy endeavours to fill the so-called “gap” housing vacuum. The policy framework presented is an aggressive and bold indication of government’s commitment to making the social housing sector work because of the benefits that it brings to the country (South Africa: Social Housing Policy, 2005: 5).

From the development focus of the Medium Term Strategic Framework (MTSF), the government has derived twelve outcomes that set the guidelines for a more result driven performance and provides strategic focus for work up to 2014. Outcome 8, Sustainable Human Settlements and Improved Quality of Household Life, forms the basis of the targets for sustainable human settlements development. The delivery agreement for Outcome 8 has four measurable outputs, which include accelerated delivery of housing opportunities, improved access to basic services, higher efficiency in land utilization and improvement of the property market (Millennium Development Goals, 2010: 18).

If funding individual housing and residential units are promoted by the South African Government with several institutions established to manage various aspects of the value process addressed. The challenge seems to open the opportunity to a more sustainable delivery process [Keeping in mind that the affordability of the providing strategy is questioned (see paragraph 1.1 on p. 1)].

2.4.3 National Strategies

Housing delivery - be it green or not - in South Africa, is guided by development plans. The Reconstruction and Development Programme (RDP) relied on six basic principles, which together made up the political and economic underpinning of the RDP (South Africa, 1994). These are: an integrated and sustainable programme, a people-driven process, peace and security for all, nation building, linking reconstruction and development and the democratization of South Africa (South Africa, 1994). The five key programmes of the RDP involved: meeting basic needs, developing human resources, building the economy, democratizing the state and society and implementing the RDP (South Africa, 1994).

The New Comprehensive Plan for Sustainable Development, commonly referred to as Breaking New Ground (BNG), was introduced in 2004 as part of a ten-year review of the 1994 housing programme (Department of Human Settlements, 2009). This plan was developed in support of accelerating housing delivery, transforming the housing market to address all aspects, such as social, economic and environmental integration and inclusion (Department of Human Settlements, 2009).

The Department of Housing (2002) stated that the most critical threats to the sustainability of settlements in South Africa are water scarcity, crime and the fear of crime, HIV/AIDS, growing poverty, institutional complexity and the underperformance and inefficiency of certain parts of the public sector. The Provincial Government of the Western Cape (2010) stated that some key constraints to housing delivery include among others: demand that exceeding supply; accelerating provision of basic service which increases pressure on municipal bulk infrastructure; a gap in the housing market that excludes low income groups from both subsidies and mortgage loans; beneficiaries who rent out or sell houses at a fraction of the value and that development is hampered by inadequate coordination between different spheres of government.

Additional challenges facing the delivery of sustainable development may include appropriate building technologies, ecologically sound designs, low energy consumption and renewable energy, selective efficient use of resources and

recycling, ecological principles to guide development and the use of public participation in decision making processes (United Nations. ECE, 2001: 5).

Despite the many plans and programmes currently in place; pitfall exists in the implementation. As already stated in paragraph 1.1 (on p.1), the South African government faces challenges of delivery and capacity. Figure 4 exemplifies the process of planning for certain delivery targets and objectives. Figure 4 illustrates that objectives are measured by outputs, aims by outcomes and targets by the impacts that have been made. If the positive impact recorded as benefits for green construction falls within the parameters of sustainable development, one could review the planning and evaluation process backwards and forth. With increased value in terms of economic, social and environmental benefits the target should be housing the nation in a sustainable manner with the aim of lessening the financial burden on government, increase the livelihoods of the poor and direct the inputs of all institutions already structured for housing delivery.

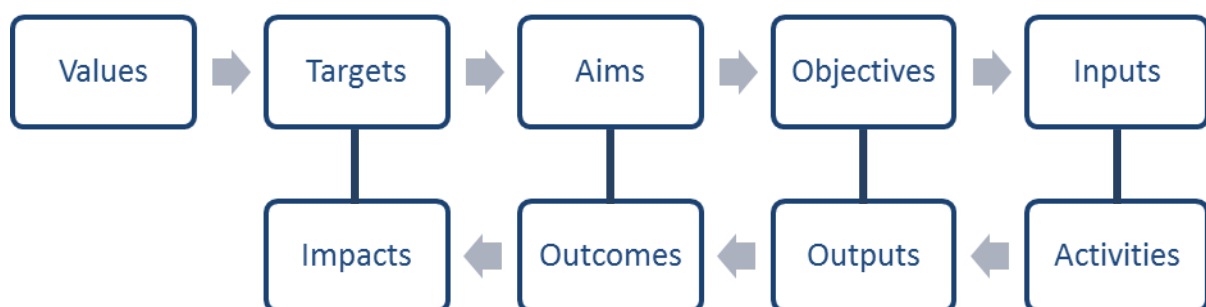


Figure 4: Planning and evaluation process

Source: Greyling and Verster (2012)

The housing targets and the impact of housing delivery need to be supported by finances and capacity. With an increased demand for housing, a continuous increasing backlog, a socio-economic struggling community, growing population and urbanization, sustainable human settlement development is challenged (Department of Environmental Affairs, 2012: 62). The housing sector targets growth in physical housing stock and the growth in the economic value of the housing sector (Xue, 2012: 20). Seemingly the systems and processes are already established to promote green construction.

The systems, mechanisms and processes illustrated in Figure 5 are interlinked and should be instrumental in promoting change.

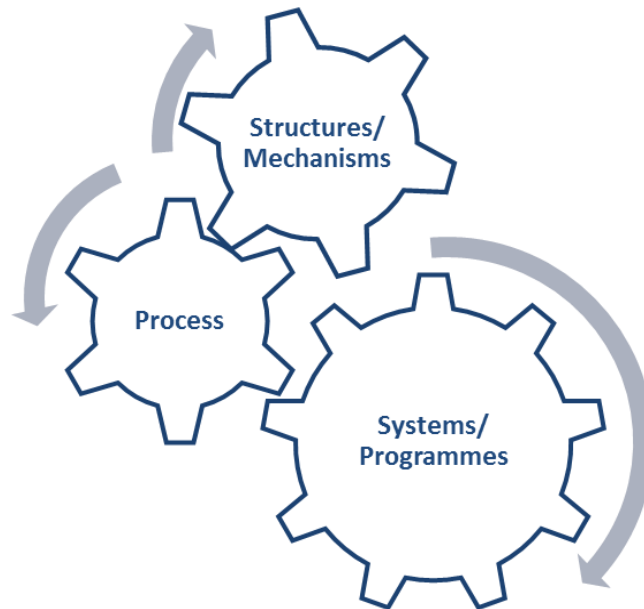


Figure 5: The South African housing framework

Source: Greyling and Verster (2012)

The Local Government Turnaround Strategy (COGTA, 2009) is aimed at counteracting forces that are undermining our Local Government system. Root causes of some of these problems include:

- Systemic factors
- Policy and legislative factors
- Political factors
- Weaknesses in the accountability system
- Capacity and skills constraints
- Weak intergovernmental support and oversight
- Issues associated with the intergovernmental fiscal system (Department of Cooperative Governance and Traditional Affairs, 2009: 23-34).

Addressing the eradication of service and infrastructure, demands should be considered when considering housing, as it forms an integral aspect of the entire

housing delivery process. Whilst considering the possibility of going green, Table 4 presents additional service delivery targets set in the Local Government Turnaround Strategy.

Table 4: Minimum standards for service delivery

Sector	Minimum Standard Target 2014
Water	All households to have access to at least clean piped water 200m from household
Sanitation	All households to have access to at least a ventilated pit latrine on site
Electricity	All households to be connected to the national grid
Refuse Removal	All households to have access to weekly refuse removal services
Housing	All existing informal settlements to be formalized with land-use plans for economic and social facilities and with provision of permanent basic services
Other (education, health, roads and transport, recreation, etc.)	Standards for access for all other social, government and economic services must be clearly defined, planned and where possible implemented by each sector, working together with municipalities in the development and implementation of Integrated Development Plans (IDPs)

Source: Department of Cooperative Governance and Traditional Affairs (2009: 23-34)

The above targets for service delivery were revised in the MTSF 2014-2019 and includes the following targets:

- Increase in the percentage of households with access to a functional water service from 85% in 2013 to 90% by 2019
- Increase in the percentage of households with access to a functional sanitation service from 84% in 2013 to 90% by 2019, including elimination of bucket sanitation in the formal areas
- 1.4 million additional households to be connected to the grid between 2014 and 2019, and 105 000 additional non-grid connections (Department of Planning, Monitoring and Evaluation, 2014: 28).

It seems possible to address energy, water infrastructure and housing in the same green context. The main constrain namely costs, may be the determining factor to investigate.

2.5 BARRIERS TO SUSTAINABLE HUMAN SETTLEMENT PROGRAMMES

Sustainable development should attempt to minimize the barriers and maximize the drivers of sustainability. Several authors identified barriers to sustainable development as summarized in Table 5.

Table 5: Barriers to sustainable design and construction

Economic	Social	Environmental
<ul style="list-style-type: none"> ▪ cost premium of sustainable design and construction ▪ requirement for long payback periods from implementing sustainable practices and technologies ▪ high cost for sustainable materials and products ▪ recovery of long-term savings not reflected in service fee structure and the extension of project schedules ▪ affordability involving the cost of interventions, household incomes, levels of fuel use and cost-benefit allocation ▪ cost of energy from ESKOM and local governments and the influence on consumers ▪ access to finance which includes bridging finance, financing for households 	<ul style="list-style-type: none"> ▪ rules of competition and tendering ▪ functioning of value chains ▪ possibilities to apply integrated design processes ▪ a lack of knowledge and ignorance of existing efficient sustainable building technologies ▪ a lack of demand and drawbacks in sustainable building marketing processes ▪ concerning warranties and risks on non-standard sustainable materials and methods ▪ tendency to maintain current practices ▪ conflicting public policy and/or regulations ▪ lack of an integrated work environment among all stakeholders ▪ awareness relating to all 	<ul style="list-style-type: none"> ▪ lack of awareness from clients (owner/developer) ▪ limited sustainable knowledge and understanding from contractor ▪ limited sustainable knowledge and understanding from subcontractors ▪ lack of knowledge and understanding from design professionals ▪ unfamiliarity of sustainable materials and products ▪ limited supply of sustainable materials and products ▪ inefficient awareness and understanding of energy efficiency among building professionals, which limit their involvement in sustainable building activity and results in poor installation of

<p>and the payback timeframes related to such finance</p> <ul style="list-style-type: none"> ▪ a lack of transparency of energy use and cost, resulting in a limited focus on energy cost by all those in the building value chain, with viable investment opportunities overlooked and installed technology not operating at optimal levels ▪ a lack of adequate offers (affordable and quality energy efficient solutions for new constructions and retrofitted works, adapted to local contexts) ▪ split incentives between building owners and users, which means that the returns on energy efficiency investments do not go to those making the investment 	<p>spheres of government, professionals, housing developers and also housing consumers</p> <ul style="list-style-type: none"> ▪ national and provincial government capacity ▪ government regulations ▪ public policies that fail to encourage the most energy-efficient approaches and practices, or actively discouraging them ▪ delays and poor enforcement of policies and building codes, which concerns all countries ▪ complexity and fragmentation in the building value chain, which inhibits a holistic approach to building design and use 	<p>energy-related equipment.</p>
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Source: Adapted from Klunne (2002: 41), Ahn, Pearce, Wang and Wang (2013: 39), Hakkinen and Belloni (2011) and WBCSD (2009: 12)

From the foregoing, it can be concluded that governmental policy frameworks, regulations and standards should be addressed in order to promote sustainable development. If it is assumed that green buildings and construction contributes directly to sustainable development, it is necessary to embark on the same analysis. Therefore, firstly, barriers to going green are investigated.

WBCSD (2009: 36) suggest that major barriers of green building are those that allow and encourage inefficient use of space heating, including: construction practices that produce inadequate building envelopes and building codes that are weak; lack of systematic and rigorous enforcement of building energy codes; a lack of incentives to save energy and out-date heating system design and a lack of proper heating controls. Henn and Hoffman (2013) asserts that the integrative approach to green construction represents a new process that promises tight integration of systems. However, the new approach also threatens to disrupt the “enduring, structure role system” with the potential to create either a leadership vacuum or organizational mayhem. These possibilities lead to too many role-players resisting the integrative design process.

Once standards are written, decision-makers within organizations often become constrained by rigid rules that preclude the search for creative solutions to complex environmental problems. At times, these standards can explicitly restrict environmentally optimal solutions (Henn and Hoffman, 2013).

2.5.1 Challenges facing sustainable human settlement development

South Africa, with its legacy of apartheid, inherited a diverse, unbalanced society with racial segregation and a clear distinction between the rich and the poor (Findley & Ogbu, 2011: Online). As a result, the South African Government faces several challenges of restructuring human settlements. These include amongst others:

- affordability, well-located land for low cost housing often located in existing areas (weak for integration)
- national policy and provincial allocation
- number of growing applications for subsidies
- lack of capacity
- inability of recipients of housing subsidies to afford municipal services and taxes (Centre for Development Support, 2010).

South Africa with its nine provinces, eleven official languages, seventeen different types of municipalities, much religious and cultural diversity and extremes in poverty

and wealth, faces diversity and imbalances in providing for human settlements. Other critical challenges include services such as water scarcity, safety versus crime and the fear of crime, health and fight against HIV/AIDS, growing poverty, institutional complexity, underperformance and inefficiency of parts of the public sector (Du Plessis & Landman, 2002: 4). Several dimensions should be considered in the context of transforming human settlements in South Africa into environmentally friendly towns and cities.

2.6 CRITICAL SUCCESS FACTORS FOR SUSTAINABLE HUMAN SETTLEMENTS

A variety of critical success factors (CSF) have been established for the delivery and provision of sustainable social housing developments in various countries. Ihuah, Kakula and Eaton (2014: 69) ranked CSF as indicated in the Table 6.

Table 6: Critical success factors for sustainable public housing delivery and provision in Nigeria

Rank	Critical Success Factors (CSF)	Rank	Critical Success Factors (CSF)
1	Competent project team	12	Project understanding
2	Land issues	13	Project mission/common goals
3	Effective housing policy implementation	14	Project information/communication
4	Housing project ownership	15	Project team composition
5	Top management support	16	Adequate project planning
6	Adequate project fund and resources	17	Weather condition
7	Adequate project monitoring and feedback	18	Project risk management
8	End users involvement/inclusion	19	Cultural difference
9	Project manager/leader authority	20	Adequate project control
10	Realistic project cost and time estimates	21	Project site condition
11	Building materials and its increasing cost	22	Project problem solving abilities

Source: Ihuah, Kakula and Eaton (2014: 69)

From Table 6 it may be observed that the most prominent CSF for sustainable public housing delivery and provision are competent project teams, land issues and effective housing policy implementation. The least prominent CSF that are highlighted include adequate project control, project site conditions and project problem solving abilities. It would be beneficial to focus efforts on improving CSF that are ranked as more prominent. Other critical success factors that have been determined by various other researches can be seen in Table 7.

Table 7: Process success factors

Success Factors	Researches that mentioned and emphasized Success Factors
Consensus building	GHK, 2000; VNG International, 2005; Steinberg, 2005; Wong, Tang, Horen, 2006; Halla, 2007; Cities Alliance, 2002, 2006b, 2009, UN-Habitat, 2009
Participation of key stakeholders	Nutt, Backoff, 1987; Vinzant, Vinzant, 1996, GHK, 2000; UN-Habitat, 2002; Steinberg, 2005; Poister, Strieb, 2005; ECON & CLG, UTS, 2005; Cities Alliance, 2005; Wong, Tang, Horen, 2006; Berry, 2007; UN-Habitat, 2007; de Graaf, Dewulf, 2010
Ownership	UN-Habitat 2002, ECON & CLG, UTS, 2005
Financial resources and innovative finance	Nutt, Backoff, 1987; Vinzant, Vinzant, 1996, GHK, 2000; UN-Habitat, 2002; Steinberg, 2005; Poister, Strieb, 2005; ECON & CLG, UTS, 2005; VNG International, 2005; Cities Alliance, 2006b
Institutionalization	GHK, 2000; UN-Habitat, 2002; Steinberg, 2005; Poister, Streib, 2005; ECON & CLG, UTS, 2005; Cities Alliance, 2005; Wong, Tong, Horen, 2006; Cities Alliance, 2006b; Cities Alliance, 2009; McBain, Smith, 2010
Leadership	GHK, 2000; UN-Habitat, 2002; VNG International, 2005; Berry, 2007; Watson, 2009; Cities Alliance, 2009
Capacity building	UN-Habitat, 2002; ECON & CLG, UTS, 2005; VNG International, 2005; Berry, 2007; Watson, 2009; Cities Alliance, 2009
Early success	GHK, 2000; UN-Habitat, 2002
Supportive national policy	GHK, 2000; Cities Alliance, 2009
Suitable monitoring and evaluation	GHK, 2000

systems	
Capitalize on existing initiatives in cities	UN-Habitat, 2002; Cities Alliance, 2005

Source: Rasoolimanesh, Badarulzaman and Jafaar (2013: 68)

Table 7 indicates the success factors, as identified by a variety of researchers. This is included in order to determine what most researched regard and have found to be the most important factors to the successful delivery of housing (specifically with regards to low-cost public funded housing). The factor that was supported by many researchers was consensus building, this entails bringing together of all stakeholders in order to make decisions. The factor that was seen as important by fewer researchers are suitable monitoring and evaluation systems.

2.7 COST IMPLICATIONS OF SUSTAINABLE HUMAN SETTLEMENTS

If the potential for going green as an attempt to contribute to sustainable human settlements and housing is considered, the main concern would be the financial implication. Questions regarding the cost of going green would be asked. This section therefore aims to investigate the cost implications of current versus future sustainable green construction practices and to determine the 'real' cost involved in green building requires consideration of material, process and support. It could be concluded that a variety of costs are involved in changing from conventional building to green building (Kibert, 2016). Some of these costs could be direct, other support cost of effort, opportunity cost and social investment. The different costs will be investigated with specific reference to the life cycle cost analyses. The interlinked nature of some of the cost items discussed in this chapter might be difficult to compartmentalize and/or categorized and therefore reference to the type of cost will be made in each paragraph.

2.7.1 Principles of sustainable construction

Kibert (2016) refers to sustainable construction as the creation of a healthy built environment using amongst others resource-efficient principles. Any building application directly has a cost implication. If the earth's principal natural resource-

protection (Kibert, 2016) is considered, surely there may be assumed to be some cost implications. Any guidelines for sustainable buildings by the construction industry need to consider the cost effect (Dragar, 1996). Some useful criteria to judge the level of elemental cost impact on the building in general are shared.

Table 8 : Principles of Sustainable Construction

1	Reduce resource consumption (reduce)
2	Reuse resources (reuse)
3	Use recyclable resources (recycle)
4	Protect nature (nature)
5	Eliminate toxics (toxics)
6	Apply life-cycle costing (economics)
7	Focus on quality (quality)

Source: Kibert (2016)

According to Kibert (2016), Table 8 indicates principles that are encompassed in sustainable construction. The first principle comprises the reduction of resource consumption and revolves around passive measures to provide heating, cooling, ventilation and lighting. The second principle covers the reusing of resources, and includes materials and water. The last principle focuses on quality which includes the planning of communities, excellence in design of buildings, selection of materials and energy systems along with the design of passive lighting and electrical systems.

2.7.2 Cost elements of sustainable construction

For the purpose of this study, the researcher identified the two main categories of cost-related elements that impact on green building:

- Direct costs – that are involved in the actual cost of the building
- Indirect cost – could be calculated from aspects such as design and choice of technology (Tsai, Yang, Chang and Lee, 2014).

As an indirect cost, the cost of effort, lifecycle cost and opportunity costs are identified.

- Cost of effort involves the cost of considering, developing and imposing green aspect of building
- Life cycle cost relates to the life span of the building
- Opportunity costs involve social and environmental benefits and investment.
- Opportunity cost is the most difficult aspect to put a real cost value to, but can't be ignored (USGBC, 2008).

To further ensure a common understanding of elements referred to in the section, each element is defined as follows:

- Design considerations involve the minimum size and facilities and is informed by the natural elements
- Building material includes the minimum strength and classifications of building materials to be used in the subsidized houses
- Applied technology referring to insulation, flooring and windows
- Energy consumption (long- and short-term) includes considerations in terms of water supply and thermal efficiency
- Renewable and recycled resources includes the use of recycled materials and renewable energy sources such as solar energy
- Support costs (South Africa. Department of Human Settlements, 2009)

For the purpose of analysing the various cost elements on the building process, the major cost elements are identified and categorized as indicated in Table 9:

Table 9: Cost elements in the building process

Direct cost	Indirect cost		
	Cost of effort	Life cycle cost	Opportunity cost
<ul style="list-style-type: none"> ▪ Building material ▪ Applied technology ▪ Energy ▪ Renewable 	<ul style="list-style-type: none"> ▪ Design ▪ Applied technology ▪ Support cost 	<ul style="list-style-type: none"> ▪ Energy ▪ Renewable resources ▪ Recycled 	<ul style="list-style-type: none"> ▪ Renewable resources ▪ Recycled resources

resources ▪ Recycled resources ▪ Water	▪ Water	resources ▪ Water	
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Source: Adapted from Tsai, Chang, Chang and Lee (2014) and Kibert (2016)

Each of these categories will be discussed in detail below.

2.7.2.1 Direct and indirect cost considerations

To analyze the real cost implication on the building, it is necessary to identify a wide spectrum of costs to be considered when performing a cost analysis:

- reduced cost of consumption
- waste disposal
- non-compliance
- reduced liability and environmental risk
- improved use of assets
- reduced operational and disposal costs
- re-use of facilities
- preparedness for future regulations and requirements (Ashworth and Perera, 2015).

Each of the above costs could potentially have a benefit that could result in a cost saving for owners. Many of these costs are not typically associated with specific projects and the associated decision processes behind their funding (Pearce, 2008: 297).

A comparison of low-income green housing with conventional housing was done by Langdon (2004b). The construction data reveals a moderate difference in average between green-rated building and standards building of about 4.6%. In addition to examining costs, Langdon (2004b) also indicated that the main cost driver is the intent and values of the building owner and project team.

2.7.2.2 Design and construction costs

Bearing in mind that the cost of the building is dependent on the design and specifications, it is important that the full project life cycle of the building should be analysed. In addition, the average South African household spends approximately 37.8% of household income on housing, water, electricity, gas, other fuels, household equipment and routine maintenance (StatsSA, 2015). This signifies that a large portion of the South African economy and green building may make a significant contribution to limiting expenses on the above items.

Burton (2010) suggests that making the building the right shape, properly placing windows and pointing the building in the right direction can reduce the building's total energy use by 30-40% at no extra cost. After including every available conservation technique on a building design, the next step in decreasing the energy and water demands of the site is passive building design (Burton, 2010). A passive building design uses numerous techniques included in the actual structural design and lot layout to significantly reduce the amount of energy needed to heat, cool and light a building and also to reduce the run-off from the site, thereby reducing the pollution and increasing infiltration and precipitation (Athienitis and Santamouris, 2013).

Integrated design is a term used in two fundamental ways in the building industry. Firstly, it refers to integration of the design team to include stakeholders not traditionally included in the process, such as constructors, future building occupants, and community stakeholders (Pearce, 2008: 295). These stakeholders contribute to the design process in many ways, ranging from identifying potential constructability problems that could lead to construction change orders, delays, or disputes, to pointing out issues that will be critical for achieving buy-in and reducing potential implementation barriers (Pearce, 2008: 295). Secondly, integrated design refers to a design process in which systems are developed in concert with one another rather than independently, and interrelationships between systems are exploited to optimize system performance and maximize cost savings (Pearce, 2008: 295). The cost of effort mainly relates to time and effort and is therefore difficult to calculate. The significant of this is the long-term cost saving for the end-user.

According to a study done by Jay, Massyn, Viruly and Le Jeune (2013), the complexity of sustainable design requires continuous debate. Professional involvement within the built environment should attempt to minimize poor practices so as to produce structures that require less amounts of energy and therefore decrease the operating costs (Frans, Cumberlege & Dent, 2013). Green building requires an alternative approach from the developer. Green building consultants are required from an early stage in the project to create an environmentally conscious integrated design to ensure that minimal add-ons are required in the latter stages of the building development (May, Cheney & Roper, 2007). Although involved commitment and assistance cannot be measured in terms of extra cost, it is prudent to determine the level of time and effort required from the construction team to promote green building (Cruywagen, 2013).

i) Site Selection

Harrison and Todes (2015) describe South African settlements and cities as inefficient and spatially distorted, with low-density urban sprawl, mono-functional areas and the poor and newly urban trapped in large dysfunctional townships on the outskirts of the city, therefore rendering them unsustainable. There is a need for a change in focus from mobility to accessibility (Lyons, 2016). There are two main approaches to this: densification of residential erven and mixed-use development to allow residential erven to be situated closer to workplaces and amenities (City of Cape Town, 2009). Efficient urban design will improve the quality of life and living environment at no additional monetary cost. It has been demonstrated that feasible layouts of high-density alternatives versus South Africa's current trend of stand-alone housing units, result in productive land use and direct cost saving (Ross, Bowen & Lincoln, 2010: 442).

ii) Design Phase

Most of the products specified in the design documentation, if carefully considered for its contribution to green building, have a direct cost implication (in most cases a cost saving) for the end-user (WGBC, 2014).

Passive solar design is characterized by the use of building elements such as walls, windows and floors to perform the functions of collection and storage of solar thermal

energy (Athienitis and Santamouris, 2013). Burton (2010) suggests that passive buildings collect, store and distribute heat from solar energy by the processes of convection, conduction and radiation. Roaf, Fuentes and Thomas-Rees (2014) indicate that today's passive solar design systems can typically provide 30-70% of residential heating requirements, depending on the size of the system, the level of energy conservation in the building envelope and the local climate. Ramsdell (2011) suggests that there are five design components that should be included in passive solar design, namely: energy efficiency, orientation, glazing, thermal mass and heat distribution. Hatton (2003) argues that passive solar design seems to be a 'rational' choice as it has features which hold no or little cost, with cost often being a barrier to implementation. Passive design is energy-efficient design which makes the most of local conditions to make homes more comfortable while reducing consumption bills. Passive design costs no more when included at the planning stage the direct cost involved, but also a saving during the life cycle of the building.

By using the most efficient source of electric light in the most effective ways and by capturing more of the daylight reaching buildings, up to 90% of electricity used for lighting can be profitably saved (Du Toit, 1998: 168). Ramsdell (2011) argues that making use of daylighting (natural) compared to artificial lighting will save costs on electricity.

Roaf *et al.* (2014) define ventilation as the controlled removal of pollutant-laden air from a house, and the corresponding replacement of the above with fresh air, which will have resulting positive effects on the human occupants. This may be accomplished through effective design, through correct placement of windows and openings, and by implication have little or no cost effect on the house/development itself. The use of local and seasonal wind data can assist in the placement of openings (Burton, 2010).

Roaf *et al.* (2014) suggest that the main ecological issues relating to the choice and design of insulation relate to ozone depletion, sustainability of the source – naturally produced and recyclable materials and the materials embodied energy. Roaf *et al.* (2014) further suggest that insulation materials such as expanded polystyrene could cost as little as £2.50 to £6.50/m², which is between R41.63 to R108.24/ m² (using

current exchange rates). This implies that for a 40m² house the cost may be as little as 2% of the current subsidy quantum (R160,513.00) for 2014 (Department of Human Settlements, 2015: Online).

The building envelope serves as a thermal bridge and has three types of heat loss/gain: conduction, radiation and convection (Guan, 2013). As windows are the weakest link in a building's thermal barrier and are responsible for 10-20% of a home's heat loss or gain, low-emissivity coatings, super-windows and retrofit window films may contribute to better performance (Du Toit, 1998: 168). South Africa's temperate climate offers the ideal conditions to be able to increase comfort levels in housing quite cost-effectively using passive thermal design (Ross *et al.*, 2010: 440). In green construction thermal mass is considered in the selection of construction materials. The thermal mass of various materials are indicated in Figure 6 below.

MATERIAL	THERMAL MASS (volumetric heat capacity, kJ/m ³ .K)
Water	4186
Concrete	2060
Sandstone	1600
Compressed Earth blocks	1740
Rammed Earth	1673
Fibre Cement Sheet (compressed)	1530
Clay Brick	1360
Earth Wall (Adobe)	1300
Autoclaved Aerated Concrete	550

Figure 6: Thermal mass of materials

Source: Burton (2010)

Figure 6 reflects the thermal mass of basic materials used in the construction process. This suggests that new materials may be investigated, as a potential green option, especially in terms of cost.

iii) Construction Phase

According to literature discussed, sustainable building is based social, economic, bio-physical and technical principles that practitioners should seek to satisfy (Hill & Bowen, 2009: 228), with a sensitivity of the different cost implications.

According to Burton (2010), the building shell is a key determinant of the energy usage intensity requirements of the building. Ramsdell (2011) suggests that buildings generate 30% of waste found in landfills. Earth construction is a sustainable solution, as excavated materials from the site are used in the building itself. It has low embodied energy and also has good thermal heat capacity (Ramsdell, 2011).

Reduction and recycling of waste could even reduce rather than add to the building cost. In the above paragraph 2.7.2.2 (from p.37), several design and construction aspects impacting on the cost of a building, were identified.

2.7.2.3 Building materials costs

The built environment in South Africa is slowly transforming towards greener building that are more energy and resource-efficient (Mehta, 2002: 27). However, greening the construction industry cannot be achieved until the materials used for construction are also green-sensitive (Ozdemirci, 2016). For such material to be specified in buildings, the architect and/or engineer need to be green and cost sensitive.

Franzoni (2011:885) relates sustainable construction materials to their whole life cycle and not non-hazardous impact on human health. Green building materials have certain features (Nazarian, 2015: 50-51). According to Nazarian (2015), the presence of one or more of these features in building materials make them environmentally sustainable (a socio-environmental investment):

- prevent pollution during the manufacturing process
- ensure that the manufacturer has taken steps to make the production process more efficient by reducing the amount of waste
- recycled content in a product suggests that the product has been partially or entirely produced from post-industrial or post-consumer waste
- reduced embodied energy (EE) reduces the total energy required to produce that material and includes the collection of the raw materials
- ensure natural materials are generally lower in embodied energy and toxicity than man-made materials

- lower construction waste reduce the need for landfill space and also provides cost savings
- use shortened transport distances, consequently reducing air pollution produced by vehicles
- is energy-efficient
- increases water treatment/conservation or increases the quality of water or reduces the amount of water used on a site and reduce the volume consumed
- is non-toxic or less toxic materials are less hazardous to construction workers and building occupants
- renewable energy systems include using wind, solar radiation and thermal heat to supplement or eliminate traditional heating, cooling and electrical systems;
- includes materials with a longer life-span than its counterparts needing to be replaced less often. Durability and low maintenance are very important features of materials;
- is re-usable – a function of the age and durability of a product. Very durable materials may have many useful years of service left once the building in which it was installed is decommissioned and may be easily extracted and installed at a new site;
- included recyclability measures the materials' capacity to be used as a resource in the creation of new products;
- increases the biodegradability of materials' potential to naturally decompose when discarded.

Materials with a reduced Embodied Energy (EE) are used in the green construction practices. A list of the EE of various construction materials are displayed in Figure 7 below.

MATERIAL	PER EMBODIED ENERGY MJ/kg
Aluminium	170
Synthetic rubber	110.0
Copper	100
Plastics - general	90
PVC	80.0
Acrylic paint	61.5
Galvanised steel	38
Hardboard	25.2
Imported dimension granite	13.9
Glass	12.7
MDF	11.3
Glue-laminated timber	11.0
Laminated veneer lumber	11.0
Plywood	10.4
Particleboard	8.0
Local dimension granite	5.9
Cement	5.6
Fibre cement	4.8*
Plasterboard	4.4
Autoclaved Aerated Concrete	3.6
Kiln dried sawn softwood	3.4
Gypsum plaster	2.9
Clay bricks	2.5
Kiln dried sawn hardwood	2.0
Precast steam-cured concrete	2.0
In situ concrete	1.9
Precast tilt-up concrete	1.9
Concrete blocks	1.5
Stabilised earth	0.7
Air dried sawn hardwood	0.5

Lawson (1996); Buildings, Materials, Energy and the Environment.
 * Figure updated from earlier version and endorsed by Dr. Lawson

Figure 7: Embodied energy of materials

Source: Lawson (1996)

Figure 7 lists the embodied energy of materials and it is suggested that materials with lower embodied energy should be used in order to be more environmentally friendly.

The cost of effort included to standardize, select and specify materials could result in direct cost savings and life cycle cost-saving for the end-user. Franzoni (2011: 885) states that besides the greening component, materials must fulfil a wide range of components established by national laws, national/international standards, codes of practice and local building habits. Material selection and specification challenge multi-dimensional aspects which includes: mechanical properties, thermal performance, acoustic performance, durability in the specific environmental context where the building will be located, weight and dimension limits, safety during handling and placing, fire and specific performances (Franzoni, 2011). All of these aspects are connected to the use of the building, aesthetic outcome, local construction traditions and cost according to the available budget. The process of selection and specification of building materials must correctly handle the relationship between cost and profit (Li, Wang, Wang & Zhang, 2012: 383).

According to Mehta (2002:24), the concrete industry is the largest user of natural resources in the world as it uses 12.6 billion tons of raw material each year. Forests around the world help to regulate the climate and extract carbon dioxide emissions. However, there has been an annual loss of 13 million hectares of forest cover since 2000 and an average of 4 million hectares of primary rainforest has been downgraded annually (St. Claire, 2011: 87). Timber products are found in doors, windows, roofing struts, facades, interior walling, flooring and panelling. Timber used in buildings should be derived from salvaged timber, which is re-used for the same function or recycled into new products from waste timber (Frans *et al.*, 2013). Direct costs, socio-environmental cost implications and life cycle cost are directly involved in the usage of these items.

Hatton (2003) suggests that apart from the above-mentioned, aspects that need to be taken into account to ensure sustainable eco-friendly developments are awareness, access to knowledge, motivation, finance, implementation, policy and programme development, market support and monitoring. Thus it can be seen that cost is only one of the considerations and may not be the most significant. The challenge for calculating the cost of green buildings is to understand the methods of assessment.

2.7.2.4 Energy costs

According to the WBCSD (2009), 80% of a building's energy is used during the building's operation, depending on the energy services. A building's share of final energy consumption is between 30-40%. Guan (2013) states that basically the impact of buildings on the process of global warming are energy consumption for operational use, energy efficiency in building material and construction and building related refrigerants. Apart from the utilization of the building, the process of generating and/or controlling energy within a building has a direct cost implication.

Roaf *et al.* (2014) suggest that the single most important measure of an object's environmental impact is provided by the concept of embodied energy which describes the amount of energy used to produce such an object. Embodied energy is an important measure because the use of non-renewable energy sources is the principal reason for environmental degradation (Roaf *et al.*, 2014). Energy-efficient

construction aims to minimize resource consumption, which involves minimizing energy, water and material consumption and minimizing land use. It also aims to maximize resource re-use including material, water and land (Akadari, Chinyio and Olomolaiye, 2012).

In a building, the system used to provide energy therefore has a direct cost bearing on the building cost, but also an indirect cost on the maintenance and utilization in the long term.

2.7.2.5 Renewable and/or recycled resources costs

Environmentally friendly construction makes use of renewable or recyclable resources including energy and materials, protects the environment through minimizing the harmful impact and restoring degraded land. It also includes creating a healthy non-toxic environment concerning both physical and psychological health. This type of construction pursues quality in the built environment in terms of settlement, design, construction and occupation. Finally, it aims to promote socio-economic sustainability (Ross *et al.*, 2010: 435-441). The WBCSD (2009) suggests that the following measures be implemented in order to create energy-efficient buildings: to cut energy demand, to produce energy locally and to use smart grids.

Renewable energy can be used to heat, cool or ventilate buildings instead of using fossil fuels. The main sources of useful renewable energy for buildings are solar, wind and geothermal resources (Edwards, 2010, cited by Jacobs, 2011). Furthermore, solar power is used in buildings to provide space heating, ventilation and lighting. The heating of water is one of the most energy-intensive activities in the home (Du Toit, 1998:168). Electric water heaters consume 42% of domestic energy and one quarter of this is wasted in standing losses (Ramdell, 2011). An environmentally friendly alternative is a solar water heater, which in a low-cost house should have a capacity of 110 litres at a cost of R6,167.75 (Value Added Tax included) (Plumblink, 2017: Online). However, this is significantly costlier than the traditional electrical water heater that costs R2,144.00 (Value Added Tax included) (Berlesell, 2017: Online). The solar water heater has a life capacity of 20 years compared to the traditional electric water heater's 5 to 10 years.

Active solar systems use external resources of energy to power blowers, pumps and other types of equipment to collect, store and convert solar energy (Kalogirou, 2013: 263-270). Benefits of the geothermal heat pump system are that they are highly energy-efficient and can also be used to aid in hot water heating; they are 30-70% more efficient than ordinary heating and air-conditioning systems; and maintenance and service costs are significantly lower than conventional HVAC systems (Self, Reddy and Rosen, 2013:). Advantages of solar water heaters include direct savings from lower energy costs; system payback within 4 to 8 years; decreased air pollution from offset of fossil fuel use; new systems are aesthetically pleasing; systems are automated and require little maintenance (Rosas-Flores, Rosas-Flores, Zayas, 2016).

2.7.2.6 Water costs

South Africa is classified as a water-stressed country, with the water demand threatening to exceed water supply. Based on a population growth rate of 0.5%, domestic demand for water is expected to grow at 219% between 1996 and 2030 (Du Plessis, Irurah & Scholes, 2003: 241). A lack of infrastructure maintenance and the location of development further contribute to increases in water scarcity (Du Plessis *et al.*, 2003: 242). Yudelson (2007, cited by Jacobs, 2011) states that it is possible to reduce overall water use in buildings, landscaping and neighbourhoods dramatically by employing aggressive strategies to reduce the use of potable water, following the 'reduce, re-use, recycle' element. The key is to manage the entire water cycle, starting with what is freely available and trying to get as many uses out of it as possible (Frans *et al.*, 2013).

In South Africa, a number of inter-related water management challenges exist, and these include: a mismatch between water supply and water demand, failure to achieve demand management targets, theft of water resources, demand management failure, decaying infrastructure, deteriorating water quality and loss of essential skills (Herold, 2009). Water-efficient-emphasis by designers will also benefit end-users. To reduce water wastage and specify efficient systems and products could have a long-term cost benefit.

To improve water efficiency in buildings, a number of water-saving measures could be introduced with minimal impact on households (Hansgrohe, 2012; Mirata and Emtairah, 2010). These may include dual-flush toilet systems at a then-current (2013) cost of R184.68, low-flow showerheads at R100.00, flow regulators at R800.00, and closure taps at R190.00 (South Africa: Department of Human Settlements, 2009). For an additional 2% of the current subsidy quantum, water saving may be improved. Du Toit (1998: 168) states that washing machines with a horizontal axis use 60% less energy than those with a vertical axis, because they use less water. Water harvesting is of particular value to low-income communities as piped water is costly and it means that gardens can be maintained even when there are municipal water restrictions. Water harvesting; however, will require upfront planning as certain roof types are not suitable for collecting water runoff when the water is to be used for drinking purposes (Ross *et al.*, 2010: 442). Water-efficiency improvements can be achieved through behavioural changes of end-users, low-cost retrofits or replacing older plumbing fittings and fixtures with modern water-efficient ones and installing rainwater harvesting and grey-water recycling systems (Hansgrohe, 2012; Mirata and Emtairah, 2010).

2.7.2.7 Cost of effort

In order to effect change, role-players and/or stakeholders in the construction industry are required to motivate change (Feige, Wallbaum and Krank, 2011: 508). Investors, manufacturers and/or suppliers, banks/financial institutions, contractors, planners/designers, end users and public authorities are targeted. Due to the potential benefits of green building covered in paragraph 2.2.3 (on p.15), construction stakeholders have in recent years begun to actively participate in this paradigm change to increase their market share or profit, as well as creating an environmentally friendly society (Ahn, Pearce & Ku, 2011: 52).

Holistic cost management starts with the conceptualizing of a project. Aspects that should be considered are:

- the impacts of design/construction decisions on life cycle costs
- opportunities to offset increases in first cost for design improvements

- externalities to be considered for better decision about costs (Pearce, 2008: 293).

i) Cost involved in changing designs

There have been recent changes made to standards and regulations in the built environment, such as the SANS204, SANS10400 and the SANS10400X (Burton, 2010). According to the City of Cape Town (2012), green buildings are perceived to be significantly more expensive than conventional buildings though it is not necessarily true. The reason given for this statement is that some building attributes, such as natural ventilation, constitutes capital cost savings to construction, while others, such as energy efficiency, bring operational cost savings to buildings. To promote green building, several incentives are proposed by the USGBC (2013: Online):

ii) Structural incentives:

- Expediting review/Permitting process: Reduction of the duration of the review and permitting process for verifiable green construction projects can result in major cost savings for the developer
- Density bonuses: Density bonuses provide an opportunity for municipalities to tie incentives to specific local public policy priorities.

iii) Financial Incentives:

- Tax credits and abatements – Many municipalities already offer tax credits and abatements as a means of advancing specific policy agendas. Abatements work by exempting property owners from paying taxes for a period of time
- Fee reductions or waivers – Some municipalities that charge fees for permit review or other permitting processes are offering reductions or waivers for developers or contractors who commit to verifiable green construction practices
- Grants – Grants for green building developers or home owners are being established by state and local governments to entice construction and renovation project teams to go green in markets that may otherwise be resistant

- Revolving loan funds – Revolving loan funds allocate low interest loans from a loan fund for those seeking to build or renovate to verifiable green building standards.

iv) Other Incentives:

- Technical assistance – Technical assistance to residential and commercial builders is commonly offered by building department staff with a professional credential of a green building expert
- Marketing Assistance – In recognition of the unique marketability of green buildings, some municipalities are offering free marketing assistance to developers and owners of green buildings which include signage, awards, websites, press releases and other means to help green builders rent and sell their properties more effectively.

2.7.3 Cost trade-offs

For low-income housing to be classified as sustainable, it must adhere to the above-mentioned principles of sustainable construction. However, it should be noted that optimizing each principle is not always feasible and trade-offs and compromises may become necessary (Hill & Bowen, 2009). Ross *et al.* (2010) state that South Africa is in a prime position to base all future housing development on principles of sustainable construction and therefore mitigate negative environmental, social and economic impacts on the industry.

The Green Building Council of South Africa (GBCSA, 2013: Online) has developed a green star rating system, which scores points in nine categories, comprising energy, emissions, transport, materials, water, management, indoor environmental quality, land use and ecology and innovation (Burton, 2010).

For South Africa to move away from its existing poor environmental and housing conditions in informal settlements (Du Plessis *et al.*, 2002), it should address the housing backlog by considering all principles of sustainable construction. Ross *et al.* (2010: 433-449) share some principles that were experienced through lessons learned in low-income housing development in South Africa:

- minimize resource consumption (direct cost)
- maximize resource re-use (direct and life cycle cost)
- use renewable/recyclable/recycled materials (direct and opportunity cost)
- protect the natural environment (social investment as an opportunity cost)
- create healthy non-toxic environments (social investment as an opportunity cost)
- pursue quality in the built environment (life cycle cost)
- promote socio-economic upliftment (social investment as an opportunity cost).

The cost trade-off will involve long-term sustainability, maintenance, affordability, improved living conditions, and economic, social and environmental benefits.

2.7.4 Life cycle assessment methods

According to Kim and Rigdon (1998), the life cycle of a building includes the pre-construction phase including manufacturing, taking into account the extraction, processing, packaging and shipping. The construction phase deals mostly with the use of the material and considers the construction, installation, operation and maintenance of the material. Finally, the post-construction phase focuses on disposal, which involves recycling and re-uses (Kim & Rigdon, 1998).

Mehta (2002:27) states that the construction industry's profitability is largely determined by fast construction schedules and not by life cycle cost savings from the preservation of materials and energy. However, experience indicates that faster construction is not always less expensive in the long run. Kneifel (2009) claims that the main motivating factor is the ability to earn value on a development and this is best illustrated by the use of life cycle cost analysis (LCCA). Buys, Bendewald and Tupper (2011) support the use of a LCCA to promote green buildings and define LCCA as a financial tool that uses discounted cash flows to evaluate a project, given a set of constraints, which include time period and cash flow. Robinson (2005) contends that developers are mainly focused on short-term profits and seldom consider long-term advantages when evaluating building projects. Green buildings are profitable in the long term and initial funding models fail to illustrate these

advantages (*ibid*). Figure 8 below illustrates the various costs considered when conducting life cycle cost accounting, the costs that are considered included direct and indirect financial costs and also contingent costs.

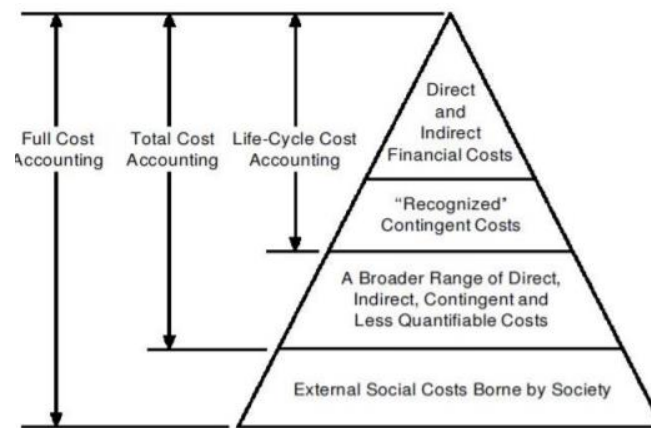


Figure 8: Costs included in LCC

Source: Cole and Sterner (2000:302)

Life Cycle Assessment (LCA) can be used successfully to make decisions in sustainable building design and construction. Nevertheless, the method is rarely utilized, for a number of reasons. First of all, in the common practice the energy consumption during the period of use is considered the main indicator of the environmental impact of buildings. Secondly, databases relative to products, components and their installation cannot be found so easily (Guardigli, Monari & Bragadin, 2011: 1199).

The lifetime of a house is typically a hundred (100) years and therefore its energy performance has long-term implications (Du Toit, 1998: 167). A sustainable development can be measured by two imperatives: socio-economic, measured through the Human Development Index, and environmental, measured through the ecological footprint (Naidoo, 2011). Brandon and Lombardi (2005: 127-136) indicate that the main assessment methods have shifted from viewing environmental costs separately to taking into account a buildings' life-cycle costs. Buildings cause environmental impacts during the whole life cycle due to use of land, use of materials and products, use of energy and use of water (Hakkinen, 2007). As shown in Figure 9, the various stages in the life cycle of a building are indicated and includes the harvesting of raw materials, production of building materials, construction,

occupation, demolition and thereafter, either recycling or disposal of building materials.

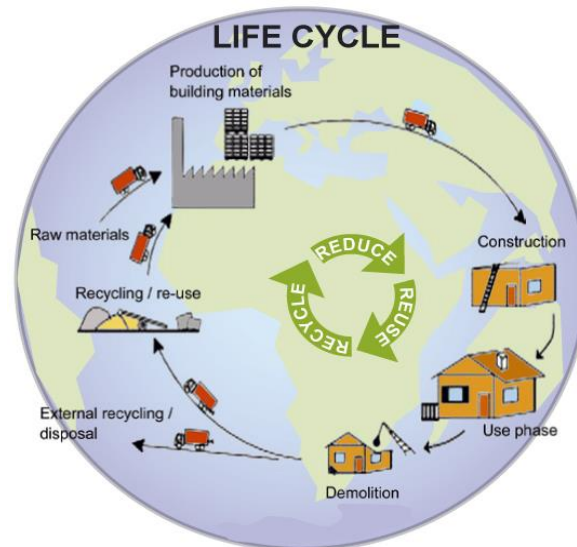


Figure 9: Life cycle of a building

Source: Burton (2010)

According to the WBCSD (2009), transformation will require integrated actions from across the building industry, from developers and building owners to governments and policy makers. Sources for LCCA include recycling, reclaimed/recycled materials, embodied energy, costs and replacement intervals (BRE Green Guide) as illustrated in Figure 10.

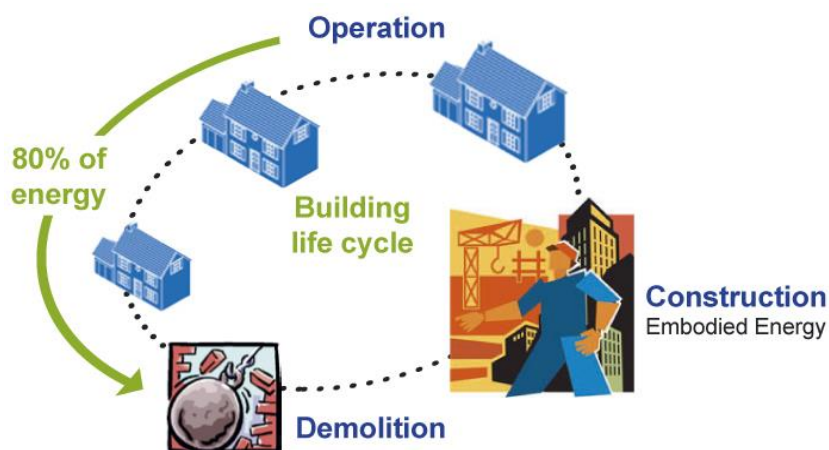


Figure 10: Building life cycle energy consumption

Source: Burton (2010)

Brandon and Lombardi (2005:127-136) indicate that the main assessment methods as illustrated in Table 10, have shifted from viewing environmental costs separately to taking into account a building's life-cycle costs. Other elements to be considered

in using life cycle cost analysis as method of comparison are cost, typical replacement interval, recycled input, recyclability, whether the material is currently recycled and the amount of energy saved by recycling. Key assessment methods are shown in Table 10.

Table 10: Main assessment methods

Main Assessment Method	Sub-Assessment Methods
Pre-Brundtland (environment in general)	<ul style="list-style-type: none"> ▪ Cost-benefit analysis aids decision-making processes and determines the viability of a project development ▪ Contingent valuation method requires eliciting valuations from customers by questioning their stated willingness to pay for an environmental improvement, or their willingness to accept compensation for a fall in the quality of the environment ▪ Hedonic pricing method determines the relationship between the attributes of a good and its price ▪ Travel cost method is based on the assumption that the cost of travel to recreational sites can be used as a measure of visitors' willingness to pay and thus their valuation of those sites ▪ Multi-criteria analysis value impacts of weighting and ranking in non-monetary terms
Post-Brundtland (life-cycle assessments)	<ul style="list-style-type: none"> ▪ Ecological footprint ▪ Environmental impact analysis involves different dimensions of a planning problem such as social, administrative and physical. It identifies potential damaging effects of proposed developments ▪ Strategic environmental assessment extends the process of EIA beyond specific projects ▪ Community impact evaluation provides the measure of total costs and benefits and of their impact on different sectors of the community, enabling the equity and social justice implications of the decisions to be taken into account ▪ Building research establishment environmental assessment method (BREEAM), certificates are awarded to individual buildings stating clearly the performance of the building against a set of defined environmental criteria

Source: Adapted from Brandon and Lombardi (2005)

Some different cost analysis methodologies have been identified in the literature and include: Budget vs Actual Method, Cost of Features Method and the Population Sampling Method (Langdon, 2007). According to Langdon (2009: 10), the question of whether going green adds cost becomes a question of perceived baseline.

One of the most common methods of assessing the cost of green is by comparing the cost of the green project with the original project budget, or the original anticipated cost of the project (Mapp, Nobe & Dunbar, 2011). This approach has two substantial problems: it assumes that the original budget was adequate to begin with, that no other changes or enhancements were made and that green features were additive (Davis Langdon, 2009). This approach is also a concern in that projects rarely report coming in under budget, so a range of reported costs will therefore typically run from 'no added cost' to positive. Also while some individual green components may be generally more expensive than their non-green counterparts, most design teams will find a way to counterbalance these costs by reducing output in some other part of the design (Davis Langdon, 2009).

Shi (2008: 15-16) suggests a number of strategies for the application of a green building assessment system in China. These include that government should make policy to promote green building assessment; green building assessment should be in accordance to international standards; green building assessment standards need to be customized; a fundamental database needs to be established in advance; and a large number of professionals of green building assessment need to be developed. These strategies may be relevant to the South African scenario although one must be aware that there are also costs involved in implementing such strategies.

According to the WBCSD (2009), transformation will require integrated actions from across the building industry, from developers and building owners to governments and policy makers. The WBCSD (2009) recommends the following steps to reduce energy consumptions and carbon emissions: strengthening codes and labelling for increased transparency, incentivizing energy-efficient investments, encouraging integrated design approaches and innovations, developing and using advanced technology to enable energy saving behaviours, developing workforce capacity for

energy saving, and mobilizing for an energy-aware culture. This may be consolidated in a policy and regulation framework.

Capital costs of a project are mainly affected by the decisions made at the inception of a project (Montoya, 2011). Budgetary constraints must be balanced by the owners and/or design team during the construction phase (capital expenditure) against the building's daily performance and long-term costs. When looking at the cost of green buildings, it must be clear whether these initial upfront costs are offset against the long-term savings in operational costs that are associated with green buildings in order to establish whether the building is more expensive or not (Cruywagen, 2013).

2.8 CHAPTER SUMMARY

This chapter has discussed the components of sustainable human settlements as well as green construction practices and procedures. The chapter also highlighted the barriers that may impede the implementation of sustainable human settlements. In addition, current challenges facing the South African low-income housing market are emphasised. This chapter identified costs in at least two categories, namely direct and indirect costs, with three indirect costs to be considered in green construction that include: life cycle costs and opportunity costs. A variety of assessment methods are discussed in this chapter. This chapter examined life cycle costing and the importance and implementation thereof in sustainable human settlements. The next chapter will present the research philosophy, approach and strategy. It will also present how data were collected, the criteria for admissibility of the data, the research methodology, how data was analysed and the ethical issues employed in the study.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter presents the research design adopted in this study. A brief discussion of some research design is highlighted and the rationale given for the choice of the selected research design. The research design was premised on the need to evolve a comprehensive and logical means of data collection amongst various procedures and processes that must be followed for generating sound research results. Furthermore, the chapter highlights the chosen research approach as well as the techniques applied in the collection and analysis of the data. Finally, a detailed narrative on the processes through which data was collected and analysed at various phases of the study in an ethical manner, is provided.

3.2 RESEARCH APPROACH

There are two approaches to follow when conducting research. The approach can either be qualitative or quantitative or a combination of the approaches that may be triangulated. The main research approach adopted in this study is a qualitative approach, as justified in paragraph 3.2.2 (on p. 57). However, an initial exploratory study was undertaken prior to the main study, which was quantitative in nature, as explained in paragraph 3.6.1 (on p. 62).

3.2.1 Quantitative approach

According to Creswell (2013), quantitative research is an approach for testing objective theories by examining the relationship among variables. These variables, in turn, can be measures, typically on instruments, that numbered data can be analysed using statistical procedures (Creswell, 2013). Wyse (2011: Online) asserts that it seeks to generalize results from a larger sample population. Quantitative research uses measurable data to formulate facts and uncover patterns in research. Data collection methods within this approach are more structured than methods used in the collection of qualitative data. Quantitative data collection methods include a variety of surveys, including online surveys, paper surveys, mobile and kiosk

surveys, face-to-face structured interviews, structured telephone interviews, longitudinal studies, website interceptors, online polls and systematic observations (Wyse, 2011: Online).

3.2.2 Qualitative approach

Creswell (2013) states the qualitative research is an approach for exploring and understanding the meaning individuals or groups ascribe to a social or human problem. The process of research involves emerging questions and procedures; data is typically collected in the participant's setting, data analysis inductively building from particulars to general themes, and the researcher making interpretations of the meaning of the data (Creswell, 2013). Qualitative data collection methods vary and use unstructured or semi-structured techniques (Wyse, 2011: Online). Wyse (2011: Online) states that some common data collection methods used in qualitative research include focus groups, individual semi-structured or unstructured interviews and participation or observations. In the present study on Sustainable Human Settlements (SHS), the emphasis is on obtaining information from various stakeholders concerning their experiences during their participation in the delivery of SHS in South Africa. Accordingly, the qualitative approach appears to be most suitable for this kind of data elicitation as it provides these individuals to share their experiences without restrictions.

3.3 RESEARCH DESIGN – PHENOMENOLOGY

Kumar (2014: 122) states that a research design is a road map that has to be followed during the research journey to discover the answers to the research questions as validly, objectively, accurately and economically as possible. It is a procedural-cum-operational plan that details what and how different methods and procedures are to be applied in research (Kumar, 2014: 122).

Phenomenological research is a design of inquiry, coming from philosophy and psychology in which the researcher describes the lived experiences of individuals about a phenomenon as described by participants (Creswell, 2013). This description culminates in the essence of the experiences for several individuals who have all

experienced the phenomenon (Creswell, 2013). This design has strong philosophical underpinnings and typically involves conducting interviews (Giorgi, 2009; Moustakas, 1994).

Given that this research was aimed at identifying the perceptions of stakeholders in sustainable human settlement developments, a phenomenological research design was adopted. The study also adopted the case study approach that is about the explicit rather than the general (Thomas, 2011: 3) and in this case, is to determine the consequences in terms of the costs of the cases in relation to green construction practices.

Two case studies were utilized namely Cosmo City and Savanna City. These case studies were chosen as they are particularly interesting by virtue of their size and the amount of recorded documentation available.

3.4 DATA COLLECTION AND ANALYSIS METHODS

3.4.1 Data collection methods

The data collection steps include setting the boundaries for the study, collecting information through unstructured or semi-structured observations and interviews, documents, and visual materials as well as establishing the protocol for recording information (Creswell, 2013). The collection procedures in qualitative research involve four basic types. These types and their strengths and weaknesses are indicated in Table 11.

Table 11: Four basic types of qualitative research data collection procedures

Data Collection Types	Options within Types	Advantages of the Type	Limitation of the Type
Observations	<ul style="list-style-type: none"> ▪ Complete participant ▪ Observer as participant ▪ Participant as 	<ul style="list-style-type: none"> ▪ Researcher has first-hand experience ▪ Researcher can record information 	<ul style="list-style-type: none"> ▪ Researcher may be seen as intrusive ▪ Private information may be observed that cannot be reported

	observer ▪ Complete observer	as it occurs ▪ Unusual aspects can be noticed ▪ Useful in exploring topics that may be uncomfortable	▪ Researcher may not have good attending and observing skills ▪ Certain participants may present special problems in gaining rapport
Interviews	▪ Face-to-face, one-on-one, in-person interview ▪ Telephone interview ▪ Focus group ▪ E-mail internet interview	▪ Useful when participants cannot be directly observed ▪ Participants can provide historical information ▪ Allows researcher control over the line of questioning	▪ Provides indirect information filtered through the view of interviewees ▪ Provides in a designated place rather than the natural setting ▪ Researcher's presence may bias responses ▪ Not all people are equally articulate and perceptive
Documents	▪ Public documents ▪ Private documents	▪ Enables a researcher to obtain the language and words of participants ▪ Can be accessed at a time convenient to the researcher ▪ Repeats data to which participants have given attention ▪ As written evidence, it save a researcher the time and expense of transcribing	▪ May be protected information unavailable to public or private access ▪ Requires researcher to search out the information in hard-to-find places ▪ Requires transcribing or optically scanning for computer entry ▪ Materials may be incomplete ▪ Documents may not be authentic or accurate
Audio-visual Materials	▪ Photographs ▪ Videotapes ▪ Art objects ▪ Computer	▪ May be an unobtrusive method of collecting data ▪ Provides an	▪ May be difficult to interpret ▪ May not be accessible publically or privately ▪ The presence of an

	messages <ul style="list-style-type: none"> ▪ Sounds ▪ Film 	opportunity for participants to directly share their reality <ul style="list-style-type: none"> ▪ It is creative in that it captures attention visually 	observer may be disruptive and affect responses
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Source: Adapted from Creswell (2013)

This study collected data through both qualitative interviews and documents. Qualitative interviews are unstructured or semi-structured and generally use open-ended questions that are few in number and intended to elicit views and opinions from the participants (Creswell, 2013). Documents reviewed in this context may include publicly available documents on the SHS, minutes of meetings, newspaper articles, etc. or private documents.

3.4.2 Data analysis methods

According to Leedy and Ormrod (2010: 142) the central task during data analysis is to identify common themes in people's descriptions of their experiences. Leedy and Ormrod (2010: 142) continue asserting that after transcribing interviews the researcher will typically take the following steps:

- Identify statements that relate to the topic
- Group statements into "meaning units"
- Seek divergent perspectives
- Construct a composite.

3.5 SELECTION OF STUDY PARTICIPANTS

Phenomenological research depends almost exclusively on interviews with carefully selected sample of participants, with a typical sample size from between 5 to 25 individuals, all of whom have had direct experience with the phenomenon being studied (Leedy and Ormrod, 2010: 141). Purposive sampling is widely used in qualitative research for the identification and selection of information-rich cases

related to the phenomenon of interest (Palinkas, Horwitz, Green, Wisdom, Duan and Hoagwood, 2015). Yin (2014: 88) states that in qualitative research, samples are likely to be chosen in a deliberate manner known as purposive sampling. The goal and purpose for selecting the specific study units is to have those that will yield the most relevant and plentiful data, given the topic of the study (Yin, 2014: 88). The purposive sampling method is adopted in this study. Saunders *et al.* (2009: 235) and Creswell (2013: 156) mention that purposive sampling enables the researcher to exercise judgement to select participants that will best enable the researcher to answer the research questions and meet the objectives. Consequently purposive sampling was used in the present study as further explained in paragraph 3.6.2.1 (on p. 63).

3.6 METHODOLOGICAL FRAMEWORK FOR THE STUDY AND ITS JUSTIFICATION

This section aims to provide a framework for the conduct of this study as depicted in Figure 11.

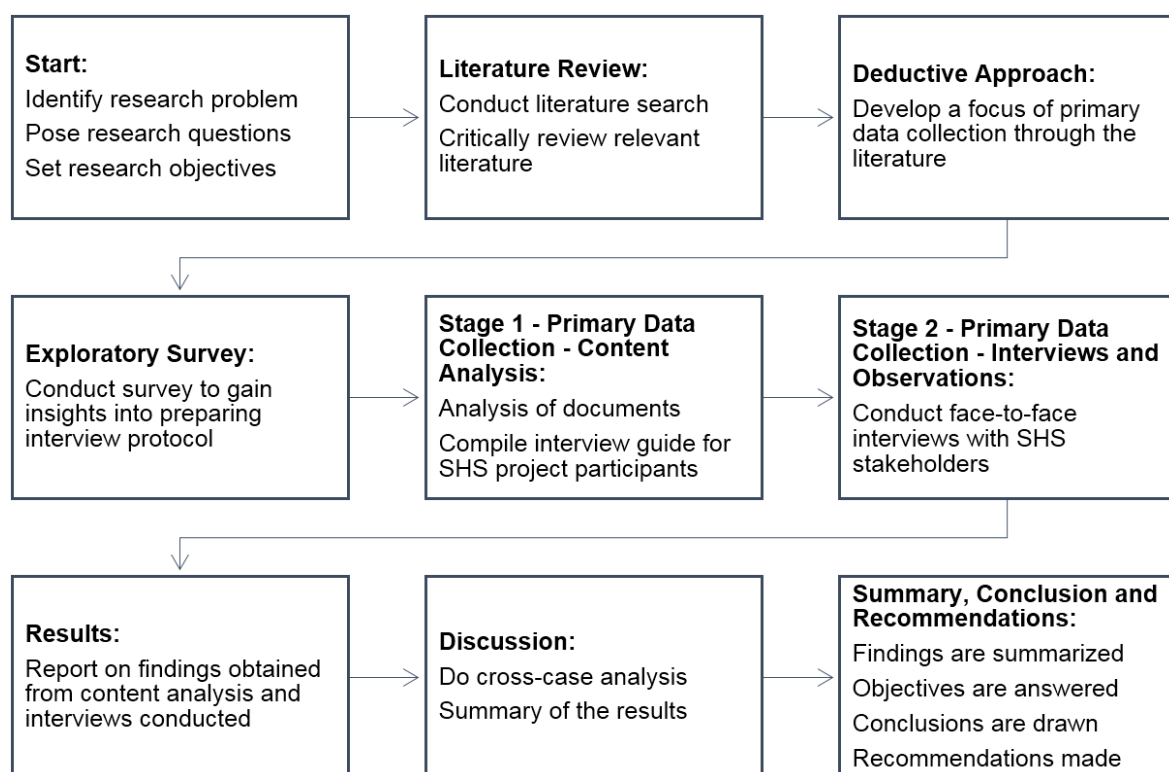


Figure 11: Schematic illustration of research strategy adopted in this study

Source: Greyling (2016: Author's own compilation)

3.6.1 Phase 1 - Exploratory survey

In phase 1 (exploratory survey), a quantitative approach was adopted. The rationale behind conducting the preliminary study was to gain an insight into the workings of the Reconstruction and Development Programme (RDP) housing delivery from the perspective of relevant professionals. Such an insight would enable the preparation of robust data collection instruments for carrying out the case studies in the second part of the data collection activity. Furthermore, the rationale for using the quantitative approach during this phase also aims to establish the current level of knowledge among professionals in the construction industry. Asking closed-ended questions seems the most effective way of gathering and comparing data. It also enables the effective presentation of figures statistically and graphically.

Evidence for a quantitative study is gathered according to a specific plan in which formal instruments are used to collect the needed information. This information is translated into numeric information and analysed using statistical procedures (Polit & Hungler, 1999: 13). The exploratory survey serves to provide the researcher with better understanding into current perceptions in order to strengthen the interview protocol that will be used in the main study. For the purpose of phase 1, participants were selected because they were active members in the construction industry in the Free State, who have had previous exposure to sustainable human settlement developments.

The questionnaire survey was circulated to participants electronically using e-mails. A return of 55% on the twenty (20) questionnaires distributed to practising professionals active within the industry, which include architects, quantity surveyors, contractors, developers and construction mentors, was recorded. The questionnaire was not limited to senior practising professionals in the construction industry. This was done to create a holistic view on sustainable human settlement practices and procedures and its related perceptions within the construction industry in the Free State.

Advantages of using e-mailed questionnaires to collect data included the following: low costs, time saving, respondents enjoyed high degree of freedom when completing questionnaires and subjects were more likely to feel that responses would remain anonymous. The issue of interviewer or investigator bias did not arise as the nature of the instrument/method/technique enabled the absence of the investigator during the time of answering the questions. Disadvantages of using e-mailed questionnaires are that the researcher had no control over whether the correct person completed the questionnaire and that a low response rate was achieved.

A structured questionnaire was developed by the researcher (see Annexure B). Respondents were assured of their anonymity and freedom to decide whether they wanted to participate in the study or not. Clear instructions were given to the respondents regarding the completion of specific items throughout the questionnaire. The questionnaire was designed in such a format that the data could easily be entered into the computer.

3.6.2 Phase 2 - Main Study

3.6.2.1 Sampling frame and size

The primary data consists of information obtained from interviews that were conducted with various key people from the construction industry. Only persons with authority and relevant experience in sustainable human settlement developments were interviewed. The sample distribution is shown in Table 12 below. Interviewees were both male and female and held different positions within their organizations. The participants had different academic qualifications, which ranged from diplomas to post-graduate qualifications.

The process of selecting interviewees included four key steps, namely:

- Identifying the types of people to interview – the persons that were more likely to provide the most significant information for the purposes of this study involved professional and governmental participants in the Savanna City and

Cosmo City project. These included architects, engineers, quantity surveyors, project managers, town-planners, developers and government officials

- Developing a screening tool – the criteria for involvement in this interview process requires the participant to have been involved in the Cosmo City Development project or have significant knowledge of the project, from external involvement or studies done on the project
- Selecting a recruiting method – participants identified were contacted electronically to gain permission to send a formal request for participation and interview date and time electronically (see Annexure for Interview Request Letter)
- Implementing the recruitment plan – ensure that the required sample size was obtained in order to produce valid results and findings (Guest, Namey & Mitchell, 2013: 121-122).

The interview participants included developers, town planners, municipal officials and professional consultant and contractors who were involved in the sustainable human settlement projects, either directly or indirectly as indicated in Table 12. Direct involvement refers to active participation on the projects and indirect involvement referring to persons who have conducted research on these projects.

Table 12: Demographics of interviewees

Interviewee	SHS Involvement	Occupation	Highest Education Level
1	Cosmo City and Savanna City	Development Director	Degree
2	Cosmo City and Savanna City	Property Development Manager	Post Graduate Degree
3	Cosmo City and Savanna City	Architect	Post Graduate Degree
4	Cosmo City and Savanna City	Town Planner	Degree
5	Social Housing	Project Manager	National Diploma
6	All SHS projects in Motheo and Xhariep District, Free State Province	Senior Home Inspector	National Diploma

7	Mdantsane Cluster and 5 projects in Free State Province	Contract Manager	National Diploma
8	Various projects in Free State, Eastern Cape Province	Operations Manager	National Diploma

Source: Greyling (2017: Author's own compilation)

3.6.2.2 Data collection techniques

The gathering of qualitative data was divided into two stages. Stage one focuses on analysing public records in the form of media reports in conjunction with reports received from the Department of Human Settlements (DHS) and Developers. The analysis of the documents led to the compilation of the questions for the interview – the interview guide (see Annexure C). Stage two of the data collection focuses on the interviews. The principle of voluntary participation was upheld in the interviews. This suggests that people were not coerced into participating in the research.

3.6.2.3 Official Records and Documentation

Secondary data were sourced through the review of existing literature in the form of journal publications, newspapers, conference papers and various official publications which were obtained from various stakeholders. The following official stakeholder publications for Cosmo City have been identified: Basil Read Developments, City of Johannesburg, Urban Dynamics and Urban LandMark. The stakeholders identified in Savanna City include Basil Read Developments, Old Mutual, Development Bank of South Africa (DBSA) and the Gauteng Provincial Government. Table 13 provides an overview of different documents that were consulted during the analysis of the Cosmo City and Savanna City case studies.

Table 13: Overview of various documents analysed as part of the case study

Document Name	Year of Publication	Type of Publication
Basil Read intensifies focus on integrated housing development to strengthen order book	2016	Online News Article
Savanna City	2016	Project Website
Savanna City	2016	Developer Website

Concept Paper – Gauteng Spatial perspective (GSP) 2030	2015	Government Document
Planning Africa: The official voice for the town planning profession	2014	Industry Magazine
Basil Read Integrated Report	2014	Company Report
Cosmo City: Not Quite New Ground	2014	Online News Article
Sedibeng District Municipality: Regional spatial development framework	2013	Government Document
State of Green Infrastructure in the Gauteng City-Region	2013	Educational Publication
Cosmo City is a Thriving Suburb	2013	Online News Article
Savanna City Creates Jobs for 54,000	2013	Online News Article
Launch of R24-billion housing development south of Johannesburg	2013	Online News Article
Savanna City: Gauteng's largest privately initiated development	2013	Developer Presentation
South Africa Builds Billion Rand City within a City	2013	Online News Article
Cosmo City: A place under the sun for everyone	2012	Company Report
Sustainable Social Housing for Cosmo City	2012	Online News Article
Cosmo City Investors' Return	2012	Online News Article
Mobilising Change Agents in Cosmo City	2012	Online News Article
Midvaal: Western region spatial development framework	2011	Government Document
Delivery Constraints in the Housing Sector	2011	Presentation
Urban LandMark Release Assessment Tool: Cosmo City case study report	2011	Company Report
Cosmo City Climate Proofing Project	2011	Government Presentation
Mixed-income housing development strategy: Perspective on Cosmo City, Johannesburg, South Africa	2010	Article
Urban Dynamics Release: Cosmo City An Integrated Housing Project	2010	Government Document
Urban Design Framework for an Integrated Mixed-Use Housing Development	2009	Architect Report

New Homes for Cosmo City	2009	Online News Article
Hlanganani At Cosmo City	2009	Company Advertisement Brochure
Environmental Management and Johannesburg City Parks	n.d.	Government Presentation
Total Sources		28

Source: Greyling (2016: Author's own Compilation)

3.6.2.4 Interviews

Data were collected through conversations and interviews as well as an in-depth document analysis. The average duration of the interviews was between 30 minutes and one hour. The data collection processes for each is detailed below. Face-to-face interviews were conducted with stakeholders of both the Savanna City and Cosmo City projects. In general, the in-depth interview exhibits the following features:

- Conducted one-on-one
- Utilize open-ended questioning
- Use inductive probing to get depth
- Looks and feels like a conversation (Guest *et al.*, 2013 :113)

The researcher developed a comprehensive interview protocol (See Annexure C). Respondents were assured of their anonymity and had the freedom to decide whether or not to participate in the study. Clear instructions were provided to the respondents and notes were taken during the interview and the data was then later typed in electronic format to enable easier use of the data gathered. The face-to-face interviews comprised two sections consisting of open-ended questions:

i) Section 1: Biographical Information

Questions regarding the respondents' age, occupation and years' experience were included in this section. The aim of including this information was to identify whether there was a relationship between the biographical data and level of knowledge regarding green construction.

ii) Section 2: In-depth open-ended questions related to the research questions with specific reference to the case studies

This section included items dealing with knowledge and experience regarding the specific case study looking specifically to green construction practices and its related costs within the context of both the Cosmo City and Savanna City projects.

The interview recordings were recorded textually (see Annexure E). The recordings were then organized by breaking them into smaller units. The statements were then grouped into categories and then into 12 themes following the interview protocol. The interview protocol was crafted to relate to the research questions in the study. The interview protocol is shown in Table 14.

Table 14: Interview protocol themes

Theme No.	Theme
1	Knowledge and experience among stakeholders
2	Policy and regulations in sustainable human settlements
3	Procurement of project materials and services
4	Social factors and perceptions in sustainable human settlements
5	Economic factors and perceptions in sustainable human settlements
6	Environmental factors and perceptions in sustainable human settlements
7	Planning of sustainable human settlements
8	Implementation of sustainable human settlement projects
9	Challenges and barriers to sustainable human settlements
10	Motivations and drivers of sustainable human settlements
11	Value creation in sustainable human settlements
12	Best practices in sustainable human settlements

Source: Greyling (2017: Author's own compilation)

3.6.2.5 Data analysis techniques

The data collected was analysed, taking Creswell's (2003: 191) recommendations for analysing qualitative data into considerations. Interviews were recorded by means of note taking as well as recordings and were transcribed. The transcripts were then organized breaking them into smaller units, in the form of stories, sentences and individual words. The statements were then grouped into categories

and then into twelve (12) themes following the interview protocol. The interview protocol was crafted to relate to the research questions in the study.

3.7 ETHICAL CONSIDERATIONS

There are several reasons why it is important to adhere to ethical norms in research. Firstly, such norms promote the aims of research, such as knowledge, truth, and avoidance of error (Shamoo & Resnik, 2015). Secondly, since research often involves a great deal of cooperation and coordination among many different people in different disciplines and institutions, ethical standards promote the values that are essential to collaborative work, such as trust, accountability, mutual respect, and fairness. Thirdly, ethical norms help to ensure that researchers can be held accountable to the public (Shamoo & Resnik, 2015).

The study was conducted in a professional manner that displays ethical principles that are authentic, reliable, current, sufficient and systematic. The following principles in particular are applicable:

3.7.1 Plagiarism

Plagiarism can be defined as ideas, thoughts, pictures, theories, words or stories that are not the creation of the writer and utilised by the writer without acknowledged (University of Michigan, 2017). Plagiarism is the act of passing somebody else's ideas and thoughts as one's own (Merriam-Webster Online Dictionary, 2016b: Online). The question of integrity, ethics and trustworthiness of the research outputs are thus jeopardised. The original source should be cited for:

- Quotations by other people and actual words
- Paraphrases of another person's words
- Uses of person's ideas, opinions, and theory
- Facts and statistics or illustrative material, unless the information is common knowledge (Helgesson and Eriksson, 2015).

3.7.2 Data management

The truthful collection of reliable data, the ownership and responsibility of collected data and the retaining and sharing of data (National Institute of Health, 2012) is referred to as data management. Each issue contributes to the integrity of the research and can easily be overlooked by researchers. Ethical data collection refers to collecting data in a way that does not harm or injure anyone. These could include physical or emotional harm by disclosing unprotected personal information. Also the securing and storing of data safely to preserve integrity is vital. A respondent's right to privacy needs to be respected (Leedy and Ormrod, 2010). The responsible use of data and truthful portrayal of data in a scientific way is according to ethical requirements.

3.7.3 Research misconduct

Any fabrication, falsification, or plagiarism in proposing, performing, or reviewing research or reporting results is viewed as research misconduct (American Physical Society, 2012: Online). Research misconduct is the process of identifying and reporting unethical or unsound research.

3.7.4 Confidentiality and anonymity

The University of Michigan (2017) differentiates between confidentiality and anonymity. When participation is confidential, the individual is obliged not to disclose any information to outsiders. Data is anonymous if no one, not even the researcher, can connect the data to the individual that provided it. Confidentiality was achieved in this study as none of the participants' identities are disclosed.

3.8 CHAPTER SUMMARY

This chapter addressed the study research design, approach and strategy adopted. The chapter also addressed how the primary and secondary data were collected as well as the criteria and admissibility of the data. The research methodology in the chapter looked at the study population, sampling technique, the sample frame and size. The chapter also informed how the data was analysed and the ethical issues considered in the study. The next chapter presents the research findings.

CHAPTER 4: ANALYSIS AND DISCUSSION OF RESULTS

4.1 INTRODUCTION

This chapter consists of two sections. The first section analyses the findings recorded from the exploratory study questionnaires on perceptions regarding green construction practices. The second section examines the case studies, revealing experiences and recorded lessons learnt from two sustainable human settlement developments and also reviews the responses from face-to-face interviews conducted and presents these findings in 12 themes.

4.2 OVERVIEW OF THE STUDY'S OBJECTIVES

In order to ensure that the empirical data gathered was aimed at being able to provide insight in terms of the research question, an alignment of questions was completed. Table 15 below gives details of the alignment of the research questions and questions in the preliminary and main study.

Table 15: Alignment of research questions and interview questions

Research Questions	Questions	Study
1. What are the factors affecting the delivery of sustainable human settlements in South Africa?	How often do you actively participate in making a project/building/development more environmentally friendly?	Exploratory Survey
	How often do you design, specify, purchase or build with environmentally friendly materials?	Exploratory Survey
	How would you rate your knowledge regarding environmentally friendly or energy efficient materials, practices and procedures?	Exploratory Survey
	Do you think there is a need for information regarding green building?	Exploratory Survey

	How would you rate and motivate your experience in planning and implementation of green construction?	Main Study
	How would you rate and motivate your knowledge in respect to planning and implementation for greening?	Main Study
	When researching green construction practices on the Case Study Project, what sources of information do you use?	Main Study
	How useful do you think these sources are?	Main Study
	Do you find or experience limitations within the information sources currently available?	Main Study
2. What are the perceptions of going green in the human settlement sector?	How much do you think the building costs will increase by?	Exploratory Survey
	Please rank the following green building focuses in order of their importance to you.	Exploratory Survey
	How did you plan and implement green construction on the Case Study Project?	Main Study
	Did you implement green construction practices on the Case Study Project and in your current projects? If not, why not?	Main Study
	When implementing greening on the Case Study Project, what did you take into consideration?	Main Study
	What do you currently consider as best practices regarding green construction in HSD?	Main Study
3. How do the prevailing perceptions	Do you think greening will increase building costs?	Exploratory Survey

affect the execution of human settlement projects?	What is your opinion regarding the planning and implementation of green construction on the Case Study Project?	Main Study
	Do you think 'going green' increased building costs on the Case Study Project? Please motivate.	Main Study
	What, in your opinion were the costs implications of green construction on the Case Study Project?	Main Study
	Did all stakeholders on the Case Study Project have consensus regarding the cost implications of 'going green'? Please motivate.	Main Study
	In your opinion, do various stakeholders shy away from greening due to a perception of increased cost?	Main Study
4. How should the cost concerns of going green in the human settlement sector be best tackled in South Africa?	According to your knowledge, how much do building (during their construction and operation) contribute to the global greenhouse gas emissions?	Exploratory Survey
	Do you think that green building is an important practice that should be encouraged by the South African Government?	Exploratory Survey
	What will most likely encourage you to participate in the green building process?	Exploratory Survey
	What would motivate you to implement greening more vigorously in your HSD?	Main Study
	Were all stakeholders involved in the Case Study Project well informed of the costs involved when 'going green'?	Main Study

Source: Greyling (2016: Author's own compilation)

4.3 DATA ANALYSIS

To establish the current alternatives available and the cost implication that they present, a literature review was conducted. A preliminary questionnaire survey was conducted to test the perceptions regarding green construction practices and its related costs in the construction industry (see Annexure A). To enable the researcher to determine the perceptions of the cost of implementing green construction practices, a questionnaire survey was utilized. The responses and opinions shared should be viewed rather as a test of perceptions than facts and served as guidelines for preparing the interview protocol used during the case studies.

4.3.1 Findings of exploratory survey

An exploratory survey was conducted to test the perceptions regarding green construction and its related costs in the construction industry. A purposive sampling method was used. A return of 55% on the twenty (20) questionnaires distributed to practicing professionals active within the industry, is recorded in Table 16.

Table 16: Responses of exploratory survey

Respondent category	Sample size	Responses	Percentage response rate
Architect	5	3	60%
Quantity Surveyor	6	3	50%
Contractor	4	2	50%
Developer	4	2	50%
Construction Mentor	1	1	100%
TOTAL	20	11	55%

Source: Greyling (2016: Author's own compilation)

The questionnaire was not limited to senior practicing professionals in the construction industry, junior practicing professionals were also included. This was done to create a holistic view on green building practices and procedures and its related perceptions within the construction industry in the Free State.

Question 1: According to your knowledge, how much do buildings (during construction and their operation) contribute to the global greenhouse gas emissions?

This question was asked in order to establish the current knowledge among industry participants regarding the contribution of the industry in general to greenhouse gas emissions. The responses will also be able to reveal the difference in perceptions among industry participants.

Only ten (10) respondents answered this question. The responses showed that the contribution of the building industry to the global greenhouse gas emissions is underestimated as 64% of respondents regard the figure below 30%, while the actual figure recorded in the literature study (WBCSD, 2009) is between 30-40% (see Figure 12).

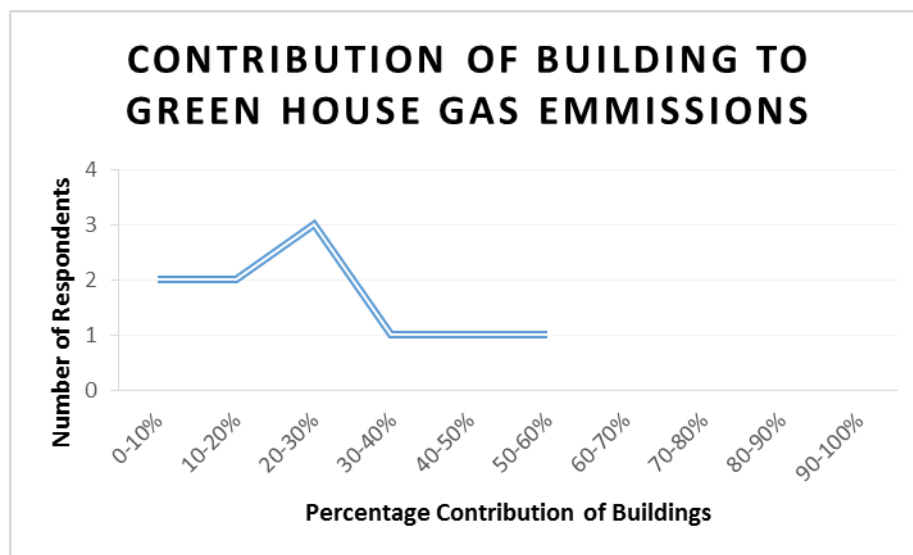


Figure 12: GHGE contributions

From Figure 12 above can be seen the difference in perception regarding the contribution of the construction and operation of buildings towards greenhouse gas emissions. The responses varied from 10% up to 60%, which is indicative that there is not much consensus among industry participants. From the responses it can be deduced that industry professionals are not fully informed regarding the contribution of the construction industry to GHGE.

Question 2: Do you think greening will increase building costs?

This question was asked in order to determine whether industry participants are of the opinion that incorporating green construction practices will increase development and construction costs. This was a simple yes/no question.

All respondents (100%) answered yes to this question. The responses therefore show that respondents are in agreement that greening would increase building costs. The responses to this question relate to literature findings that implementation of green construction practices will increase project/development costs. This is supported by the discussion of barriers to sustainable design and construction in the literature study (Klunne (2002), Ahn, Pearce, Wang and Wang (2013), Hakkinen and Belloni (2011) and WBCSD (2009)).

Question 3: By how much do you think the building costs will increase?

Having established that green construction practices would increase building costs in the previous question, this question was asked in order to establish the perceptions regarding the degree of increase in costs and also to determine the difference in perceptions among the various industry participants. The responses are revealed in Figure 13 below.

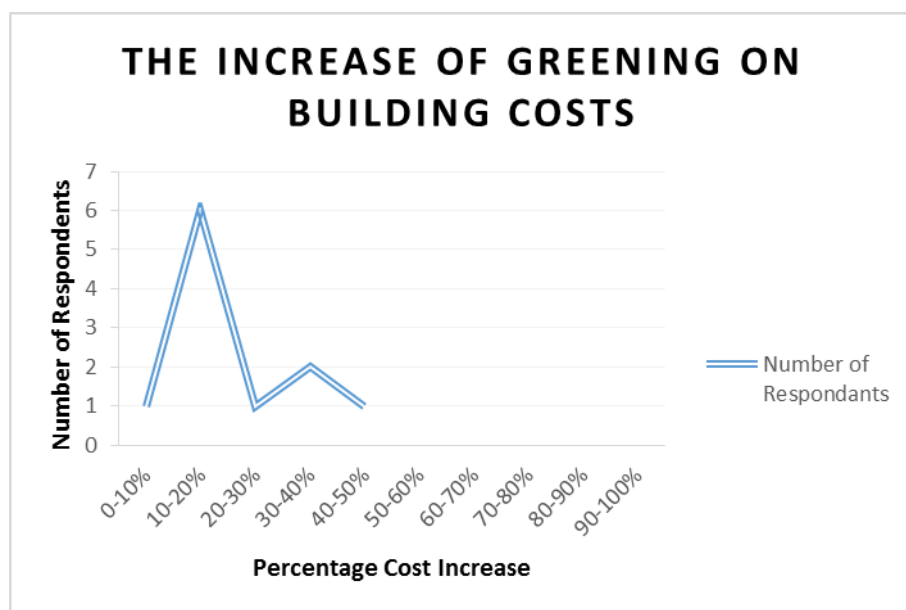


Figure 13: Building – “greening” cost increase

As seen in Figure 13, respondents were in agreement that greening will increase building costs. However, the actual increase in costs is slightly over-estimated, 55% of respondents regarded the increase to be between 10-20% which is relatively far from the actual 4.6% recorded in the literature study (Langdon, 2004a). This finding establishes that industry professionals in the Free State have not had much experience in terms of greening implementation on projects. There is a correlation between literature (Langdon, 2004a) and the empirical findings that indicates that green construction costs are over-estimated.

Question 4: Do you think that green building is an important practice that should be encouraged by the South African Government?

This question was asked in order to determine whether industry participants viewed the issue of greening of such high priority that they believe it should be endorsed, implemented and regulated by government. This was a simple yes/no response question.

All respondents (100%) answered yes to this question, which indicates that all respondents were in agreement that greening should be encouraged by the government. Literature supports this statement in the recording on critical success factors (CSF) for the implementation of sustainable settlements and the inclusion of a supportive national policy as CSF (Rasoolimanesh, Badarulzaman and Jafaar, 2013).

Question 5: How often do you actively participate in making a project/building/development more environmentally friendly?

This question determined the current commitment levels and willingness of participants to actively participate in adopting green construction practices on their projects. Responses are recorded in Figure 14 below.

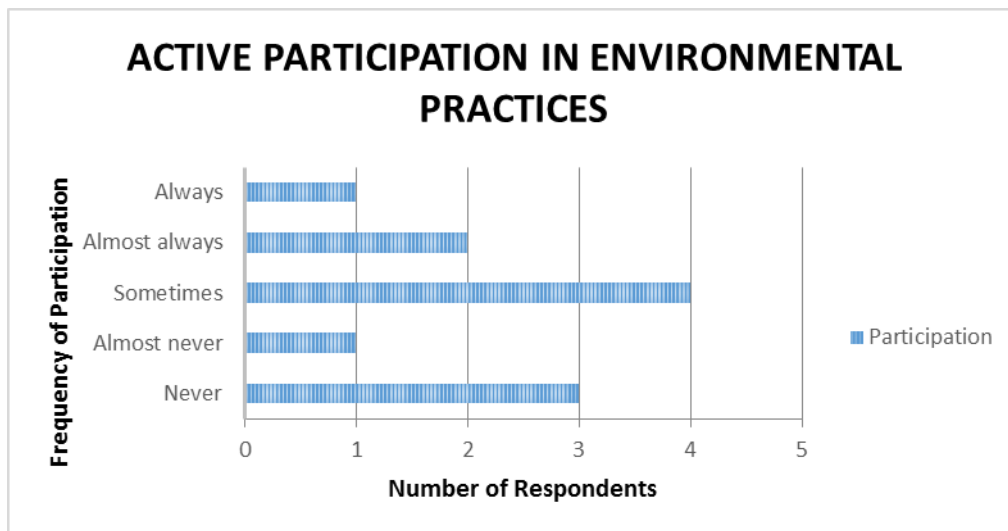


Figure 14: Active participation in environmental practices

From Figure 14 above, it can be seen that three respondents have never actively participated to make the project that they worked on, more environmentally friendly. Four of the respondents stated that they have on occasion participated on creating more environmentally friendly construction projects. These findings confirm that industry professionals have not had much exposure in terms of green construction practices.

Question 6: How often do you design, specify, purchase or build with environmentally friendly materials?

This question was included in the study to assist with determining the knowledge and experience of industry participants in working with environmentally friendly materials. The exposure includes design, specification, purchasing and construction. Figure 15 indicates how respondents viewed their design, specification and use of green building materials in making their projects more environmentally friendly.

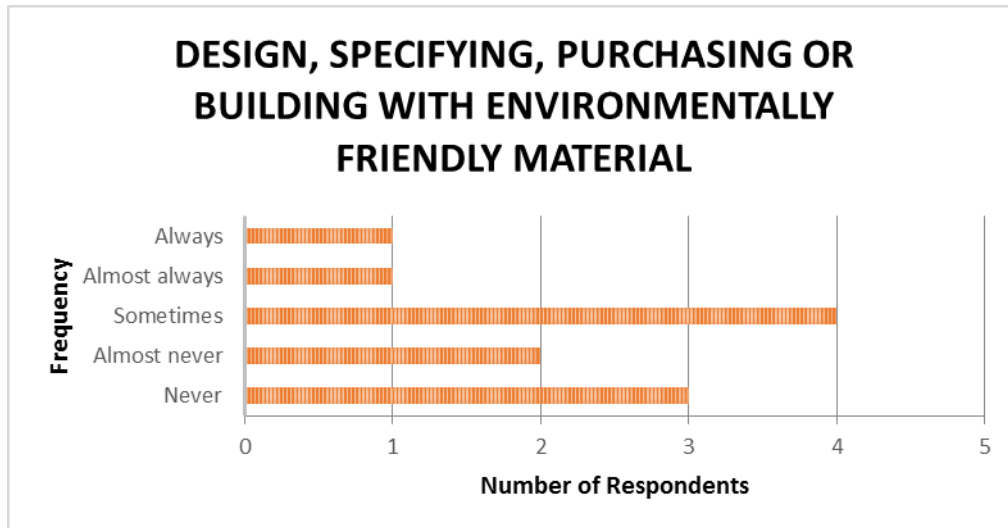


Figure 15: Rating aspects regarding the green building process

From Figure 15 above, it can be seen that the majority of respondents only designed, specified and built according to green construction principles on rare occasions. There were three respondents who had never actively designed, specified or participated in a green construction process. These findings suggest that extrinsic motivations are required for industry professionals to ensure that green construction strategies are prioritised and implemented on construction projects. The literature observations by Hakkinen and Belloni (2011) regarding the drivers of sustainable human settlements support this finding.

Question 7: How would you rate your knowledge regarding environmentally friendly or energy efficient materials, practices and procedures?

This question was included in order to determine the current level of knowledge in the construction industry in terms of practical application of green construction practices and procedures. Responses would also assist in creating a holistic view in terms of differing perceptions among industry participants.

Respondents were requested to rate their knowledge on the green construction process. Responses indicate that 55% of respondents rated their knowledge as average while 27% rated their knowledge below average. Only 18% of respondents recorded that they thought they had relatively high levels of knowledge on green construction materials, practices and procedures.

Question 8: What will most likely encourage you to participate in the green construction process?

The question was presented in the study in order to determine what motivations would be most effective in ensuring integration of green construction practices within projects.

In order to participate more actively in creating and operating “greener” developments, respondents clearly depend on government grants and operational cost savings (see Figure 16 below). Respondents were allowed to select any number of applicable motivational factors.

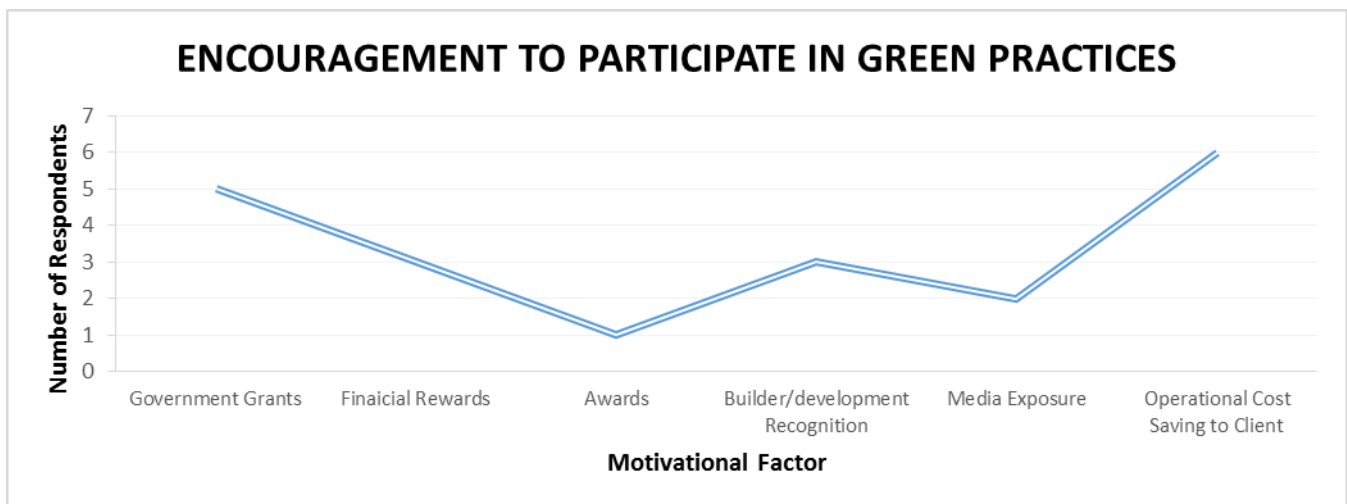


Figure 16: Encouragement for participating in the green construction process

Figure 16 indicates that the top motivation factors are operational savings to their clients rated first, government grants for greening rated second and the recognition that the builders or developer could receive and financial rewards rated third. Comments by Hakkinen and Belloni (2011) regarding the drivers of sustainable human settlements support these findings.

Question 9: Do you think there is a need for information regarding green construction?

This question was asked in order to determine whether industry participants viewed the information available regarding green construction as sufficient in scope and coverage. This question was included in order to determine whether current literature available was seen as adequate. This was a simple yes/no response question.

The responses display that all respondents (100%) were in agreement that a need exists for information regarding green construction practices. This may suggest either that industry professionals have examined the current information sources regarding green construction and have found them lacking, or that there is an ignorance regarding the topic. It may also suggest that information sources are not easily accessed. This prompted further investigation, which was done during the face-to-face interviews.

Question 10: Please rank the following green construction aspects in order of importance.

This question was probed in order to establish the variation of perceptions among industry participants in terms of what is currently deemed as important in terms of green construction practices. Responses on the various aspects (in order of importance) of green construction are displayed in Figure 17.

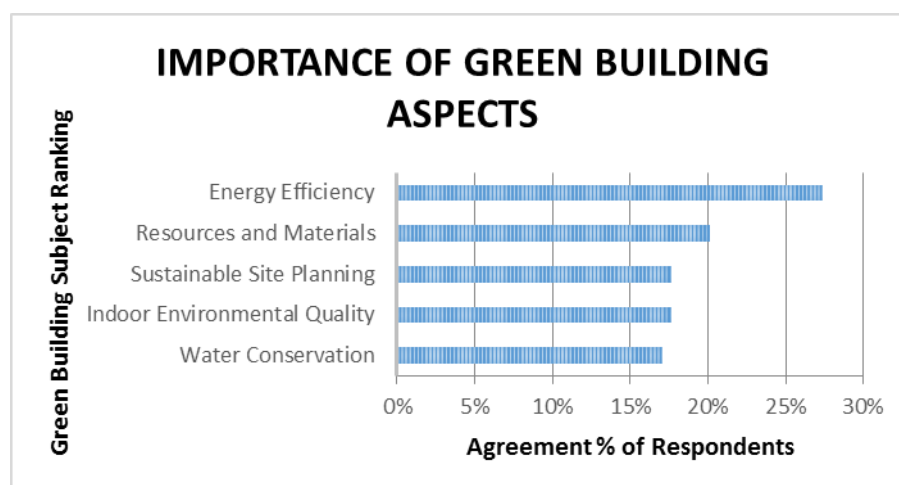


Figure 17: Importance of green construction aspects

From Figure 17 above, it can be interpreted that respondents rated energy efficiency as the most important aspect. This includes utilising and optimising energy efficiency. From the literature (Klunne, 2002., Ahn, Pearce, Wang and Wang, 2013., Hakkinen and Belloni, 2011. And WBCSD, 2009), it is clearly recorded that an overriding emphasis is placed on energy efficiency in low-income housing as a priority to promote green construction practices and by implication acknowledges the importance of alternative energy. Water conservation was seen as the least important subject according to respondents.

4.4 MAIN STUDY – DOCUMENT ANALYSIS

The following case study discussions are based on information collected and analysed from a large set of documents as set out in Table 13, (on p. 65).

4.4.1 Case description – Cosmo City, Gauteng

The case study involves the investigation of best practices involving sustainable practices. Some elements of green construction were incorporated. In the endeavour to investigate best practices, the researcher analyses two projects implemented as sustainable integrated human settlement development projects, the first namely Cosmo City in Gauteng. Lessons learnt are recorded. The information provided in this section were collected through a thorough document analysis, which included the perusal of government documents, online news articles, research papers and developers' websites and publications, as well as in-depth face-to-face interviews conducted with various stakeholders.

i) Project Background

Cosmo City is a mixed, integrated housing development with approximately 12 300 units on 1105 hectares of land North West of Johannesburg. The development offers fully subsidized, credit-linked, bonded and social housing, while also providing social and institutional facilities. The Land Availability Agreement, which commenced in 2000, resulted in a four-year delay on the project. Services installation on this development commenced in 2005. Credit-linked housing started construction in

2006/7 for phase 1 and 2010/2011 for phase 2. The final units were expected to be completed by the end of 2012. After final completion, the Cosmo City Development is expected to house between 65,000 and 70,000 people.

ii) Location

The development consists of 1 105 Ha of land, which is located 25km north-west of the Johannesburg Central Business District. The site is adjacent to Malibongwe Drive and lies between Randburg and Lanseria Airport (seen on Figure 18 below). The development is promoted as being the best-located affordable housing. The development has easy access to Randburg, Midrand, Roodepoort, Sandton and the Johannesburg Central Business District. Cosmo City relies mainly on minibus taxis for public transport. A taxi-rank has been constructed on Extension 0. Also included in the development is a fenced conservation area with a total of five parks, which are the responsibility of City Parks. Figure 18 and Figure 19 below show the location and site layout of the Cosmo City Development.

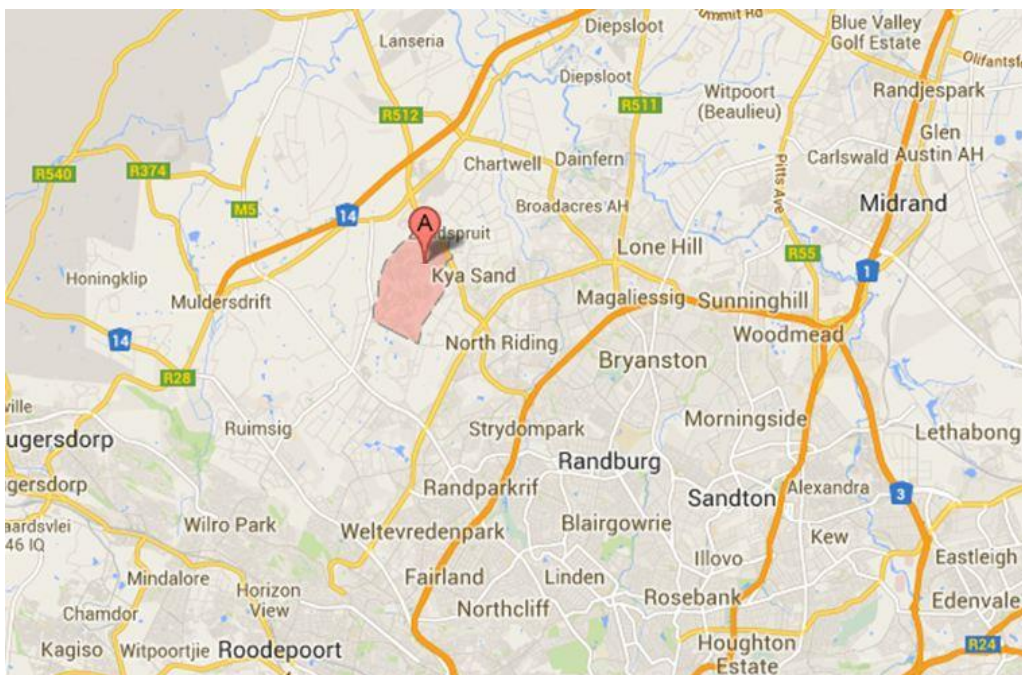


Figure 18: Cosmo City development location

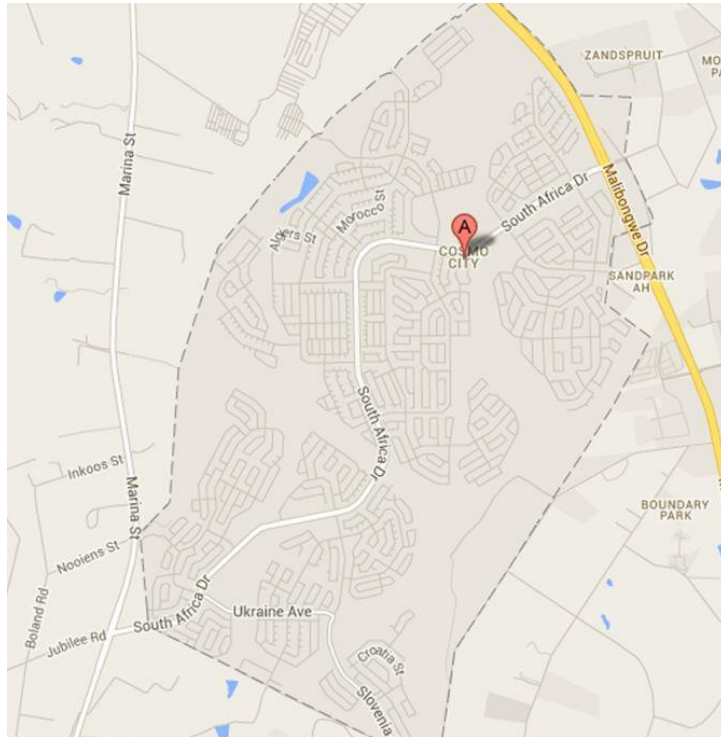


Figure 19: Cosmo City site layout

iii) Stakeholders

There were many role players involved on the Cosmo City Development, each with different duties and responsibilities. According to the documents provided (Table 13, see p. 65), Urban Dynamics prepared the bid and was responsible for the managing of the professional team up to the submission of the town planning application and was also appointed to perform all town planning and land surveying professional services. Basil Read, the developers, formed a Public Private Partnership (PPP), consisting of the following members:

- City of Johannesburg as the land owner and political champion
- Gauteng Provincial government, who provided the subsidies
- Codevco Basil Read Developments as the developer.

Codevco provided the overall planning and supply of both serviced and un-serviced sites to other developers. Other developers would then provide internal services, building top structures, institutional buildings and commercial properties (as zoning allowed). Basil Read was employed to link services and internal infrastructure for single residential stand developments by consortium with PUMA, a joint venture (JV)

between Johannesburg Financial Services (JFS) and M5 Developers. In the PUMA JV, M5 Developers were responsible for constructing all subsidized housing (including administration of subsidies), as well as the first 1000 credit-linked housing units; JFS was responsible for the rest of the credit-linked housing units as well as the bonded houses, providing both internal services in the area including some top structures and sold the rest to top-structure developers as serviced sites on consignment basis. Figure 20 illustrates the Cosmo City Development role-players.

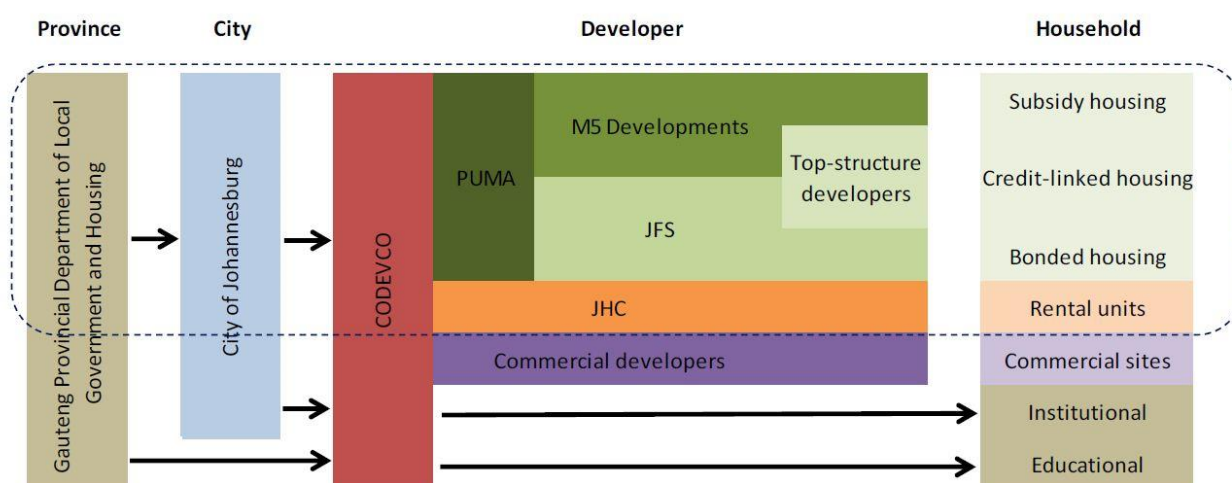


Figure 20: Cosmo City development role-players

Source: Urban LandMark (Table 13, see p. 65)

Subsidies for Breaking New Ground (BNG) and Finance Linked Individual Subsidy Programme (FLISP) housing, flowed from the province to CODEVCO and finally to PUMA. CODEVCO sold sites zoned for high-density residential use to the Johannesburg Housing Company (JHC) in 2008. Hlanganani Gardens is currently the only high-residential site, with development beginning in 2011. All private sector interests were grouped together into a single 'conceptual' developer.

iv) Land and Services

The case study documents show that the site was bought by the City of Johannesburg for R30 million. The land availability agreement was signed with the following terms: the developer pays the city R2.00/m² (net density) for every residential site sold and 50% of net profit of non-subsidized residential, commercial and institutional sites sold. The developer pays the City for the land only when

transferred to the new owner, while the City owns the land until transfer and therefore the holding cost on properties for the developer is negligible.

Cosmo City is a Greenfield development as the site was serviced with bulk infrastructure, no added requirements, keeping the development costs low. Link services of approximately R497 million were required and included arterial roads and infrastructure, which was paid by the City. High-quality services were provided, comprising entirely tarred roads, all sites having in-house water supply, water-borne sanitation in addition to pre-paid electricity. Solar geysers were provided for 170 houses in a Pilot Project in Extension 2, funded by the City for approximately R2 million. Each unit installation comprised a solar panel and geyser to the amount of R13, 000.00.

v) Housing Mix and Target Market

The developers considered a variety of housing, land, social, economic and environmental features including:

- 5000 low-income houses (R0 – R3 500 income per month)
- 3000 finance-linked houses (R3501 – R10 000 income per month)
- 1000 social rental units (less than R10 000 income per month); however, only 281 social units are available at Hlanganani Gardens
- 3300 bonded houses (open market)
- 12 educational facilities
- 40 erven for churches, clinics and crèches
- 30 erven for commercial and retail purposes
- 43 parks and recreational sites
- 40 Ha industrial park on the opposite side of Malibongwe Drive
- 300 Ha environmental area that cuts through the site
- A multi-use community centre was also developed.

The affordable land and housing data base recorded average sales of R378,786.00 in 2009 with 77% of these properties were bonded including bonded and credit-linked units along with subsidized houses on which the sales moratorium had expired.

vi) Project Funding

Provincial housing subsidies covered the cost of BNG top structures and basic services. Higher-level services were funded by the City of Johannesburg. The project's timing was essentially dictated by the City's annual housing budget. First National Bank (FNB) provided commercial loans to developers for the buildings' internal services and top structures for phase 1; credit-linked and bonded houses. Finances were recovered through sales and minimum amount FLISP subsidies. For the latter phases, NURCHA provided finances for internal services and top-structures that were financed by pre-sales. FNB Housing Finance provided end-user finance to 60% of buyers of credit-linked and bonded units. JHC borrowed R20 million from the Gauteng Partnership Fund and an undisclosed amount from JP Morgan Chase as a 'soft loan' to finance the construction of Hlanganani Gardens.

vii) Awards

The Engineering News Record (ENR) Global Best Project Award programme, awarded the Cornell University Sustainable Design (CUSD) for the Cosmo City Development, the award for South Africa's Best Project 2013. Other awards received by the Cosmo City Development include:

- Best Developer of the year
- Best Private Public Partnership of the year.

Cosmo City Development has been recognized as the model to be followed in housing delivery in order to create sustainable development.

viii) Overview of the Case Study

The main factors that contributed to the success of this development are recorded. The formulation of the Public Private Partnership (PPP), Local municipality driven and communication channels are open and readily available. The land was owned by Government. The finance-linked and bonded units lessened the pressure on bulk services and increased higher affordability of the development. By building high-density units, the full value of the land has been utilized. Social initiatives are

absolutely essential for success as low-income residents are reliant on community support. The resident received induction courses. All first-time residents of Cosmo city were introduced to the municipal by-laws and environmental issues. On-going workshops are in place which involve the local municipality. A formal Residents' Association was constituted with sub-associations for each extension/suburb. These associations promote community awareness and ownership. A local newspaper, the *Cosmo Chronicle*, serves as a platform to inform and educate and is run entirely by the local residents. Cosmo City adopted greening initiatives in the form of value-adding activities such as a nursery used to cultivate indigenous trees and shrubs and offers free training on organic vegetable gardens. There are a soup garden initiative and earthworm farms offering compost and pesticides. Gardening competitions have contributed to beautifying the environment. The only greening initiatives recorded for this project are beautifying and the integration of socio-economic initiatives within the development.

The developments are documented as examples of sustainable integrated settlements. Although the study provides valuable information for best practices, several shortfalls could be concluded. The potential for human settlements to become sustainable was incorporated to a limited extent. Synergy throughout the planning, translation and deployment in human settlement development process is essential. Synergy needs to exist between the different role players involved, i.e. government, national organizations, local communities, businesses, private sector and individuals.

In order for the settlement to be sustainable all the role players must meet their responsibilities and at the same time implement strong channels of communications with the other role players. The importance of community involvement in the offering of co-operation also needs to be emphasized. Not only mixed land use and different types of housing options secure sustainable human settlements but socio-environmental investment, socio-economic investment and environmentally friendly open areas and recreational facilities. Apart from the fact that access to social and economic amenities and job creation opportunities need to be created, green construction options should be introduced. Flexibility in design should be promoted

and house designs may be altered according to land availability, preferences and affordability (International Marketing Council of South Africa, 2005).

4.4.3 Case Description – Savanna City, Midvaal, Gauteng

The second case study is Savanna City in Gauteng. Lessons learnt on this project are also recorded. The information provided in this section was collected through a thorough document analysis, which included the perusal of government documents, online news articles, research papers and developers' websites and publications, as well as in-depth face-to-face interviews conducted with various stakeholders.

i) Project Background

Savanna City is South Africa's largest privately initiated mixed-use, integrated housing development with approximately 18 486 housing units on 1462 hectares of land south of Johannesburg. The development offers fully subsidized, credit-linked, bonded and social housing, while also providing social and institutional facilities. Site establishment started in September 2013. The project was initiated in 2007, although the service agreements were signed only in August 2013, six years later. Top structure construction commenced in February 2014.

ii) Location

The development consists of 1 462 Hectare of land located in the Midvaal Local Municipality, next to Orange Farm and Lakeside (see Figure 21 below). Also included in the development are a 400 Hectare environmental area and 111 public parks.

Figure 21 and

Figure 22 below illustrate the location and site layout of the Savanna City project.



Figure 21: Savanna City development location



Figure 22: Savanna City site layout

iii) Stakeholders

The partners on the Savanna City Development include Basil Read, The Housing Impact Fund of South Africa (HIFSA), National and Provincial Government (Gauteng), as well as the Midvaal Local Municipality (MLM), Emfuleni Local Municipality (ELM) and the Sedibeng District Municipality (SDM). Figure 23 below illustrates a list of the funders that are involved in the Savanna City Development. Urban Dynamics functions as the town and regional planners. The client/township establisher is Sugar Creek Trading 101 Pty (Ltd).



Figure 23: Savanna City development funding contributors

iv) Land and Services

All services and facilities are easily accessible (on foot and by public transport). Project impact is set to reach far beyond the current MLM (Orange Farm in the City of Johannesburg and Emfuleni), as a new sewer line is being constructed. The project will open development opportunities towards Orange Farm and the R82.

Bulk services for the development including the sewer line, will open other areas for development and deal with existing services challenges. Limited bulk services and funding for bulk services are available.

The development has some urban management challenges, including cross-boundary services issues between the City of Johannesburg, the Emfuleni Local Municipality and the Midvaal Local Municipality.

There have been a number of project delays, which have a distinctive impact on the cost of the project, including escalation. The project was initiated in 2007, but the service agreements were signed only in August 2013, six years later. Additional funding is required from investors such as HIFSA. There is limited control by the

developer on the provisioning of the sanitation transportation and treatment, specifically referring to the Emfuleni Local Municipality and Randwater.

v) Housing Mix and Target Market

The developers have aimed at a variety of housing, land, social economic and environmental inclusions:

- 5517 fully subsidized units (households earning R0 – R3500 income per month)
- 5518 finance-linked houses (households earning R3501- R10 000 income per month)
- 4792 bonded houses (open market)
- 2635 social rental units (households earning less than R10 000 income per month)
- 16 educational facilities
- 8 churches
- 9 erven for business and retail purposes
- 111 parks
- 400 hectare environmental area.

vi) Project Funding

The development is funded by Basil Read and the Housing Impact Fund of South Africa (HIFSA) with a R9 Billion fund created by Old Mutual, the Development Bank of South Africa (DBSA), the Government Employees Pension Fund (GEPF) and the Eskom Pension and Provident Fund. Further funding will be provided by the National Government and the Gauteng Department of Human Settlements.

Basil Read is a large construction company and can offer a complete turnkey solution that includes urban management services, building construction and financial modelling. Old Mutual also provides financing for the end-use as well as for the development of schools.

Fully subsidized and FLISP units attract government support in terms of bulk funding. Seventy percent (70%) of the development falls within the affordable

housing bracket with grant funding will covering 70% of bulk services within the development.

The Department of Education (DoE) will provide 100% of bulk funding and also has funding available for electrical connections (fully subsidized units). However, this is only available once development is 80% complete.

The Department of Water Affairs and Forestry (DWAF) will provide funding for the sewer line and upgrading of the Sebokeng Works.

An agreement is already signed with the Gauteng Department of Human Settlements to provide fully subsidized housing funding and FLISP subsidies. The developer is to provide 'free' land for subsidized housing. The developer is to contribute up to R35 million to the Midvaal Local Municipality for Urban Management and pay a bulk service contribution towards the new sewer line, as well as 30% of bulk service costs.

vii) Overview of the Savanna City Case Study

All services and facilities are easily accessible, either on foot or by public transport. A north-south spine linking all economic and social facilities has been provided. The development has a direct link to Lakeside, Orange Farm and surrounding agricultural areas. Open spaces are located close to residences. The various income-level households are mixed throughout the development and economic nodes are provided at various strategic locations. As Savanna City is still in the process of construction, there is not enough amount of information available for perusal. The knowledge gained and lessons learned will greatly increase during the following few years as the project nears completion.

4.5 SUMMARY OF LESSONS LEARNED

In analyzing the projects targeted in the case studies, lessons learnt were identified that could be considered when planning for future developments.

4.5.1 Lesson learned from the Cosmo City project

Various lessons were learned from the Cosmo City project and are summarized below:

- From the case study it could be concluded that integrated development (including environmentally friendly developments such as parks and recreational facilities) is essential.
- Participation and education, of beneficiaries, are an integrated part of sustainable development.
- The socio-environmental investment definitely resulted in dividends.
- The socio-economic value added by beautifying and gardening form an integrated part of sustainable development.
- Although Cosmo City is regarded as a successful sustainable human settlement development, no specific green building design or methods of building material are reported.
- Large areas of land, that is available form development, is scarce.
- Stand sizes can be decreased to 80m² with a 20m² footprint for double-storey design. However, this eliminates the potential for expansion.
- Clear green building policy guidelines need to be developed, enforced and supported by investors and, in the case of low-income housing, it is the South Africa government.
- Cosmo City is a complex case study model, due to the scale in terms of multiple building typologies and long timeframes of construction.
- Further, complications involve the number of role-players. These complications result in a difficulty in compiling figures with any degree of accuracy.

There were limited cost implications inferred from the document analysis and the cost aspects were more thoroughly explored during the face-to-face interviews.

4.5.2 Lessons learned from the Savanna City project

The different lessons learned from the Savanna City project are detailed below:

- Savanna City was driven by time constraints and it is clear from the developments that the approval processes for the establishment of townships and related services need to be streamlined.
- Delays drive project costs up and the delivery process needs to be sped up in order to avoid increased project costs.
- With reference to the affordability of the development, it is a privately owned interest-bearing property; the bulk services contribution was not subsidized, which prohibits the low-income housing component. This financial burden drives up costs.
- Affordability is influenced directly by the project timeframe, so speed is of essence.
- For the bulk service contribution, a Public Private Partnership (PPP) is considered; 20% of the BNG component can be incorporated and the service contribution can be re-couped over a period of time.
- There are multiple departments involved which were highlighted as a challenge. However, working committees were established to jointly review the project and services are facilitated timeously.
- Another challenge on the project was maintenance. The development requires long-term maintenance and has the additional impact of the new town on the existing municipal resources. In order to counteract this challenge, the developer set up a business plan for the local municipality in order to facilitate upfront planning and a periodic municipal re-evaluation done of the property value.

4.6 MAIN STUDY - FACE-TO-FACE INTERVIEWS

Eight interviewees were interviewed for their contributions to sustainable human settlement developments. The demographics of the interviewees are recorded in Annexure D.

Interviews were textually recorded, (See Annexure E). From the conducted interviews, twelve prominent themes emerged. The themes will be highlighted and both Cosmo City and Savanna City as well as other sustainable human settlement developments contributions will be deliberated under the heading of each theme.

Table 17: Thematic analysis of interview questions

Questions presented in interviews	Themes emerging from responses to each question
What is your opinion regarding the planning and implementation of green construction on SHSD projects?	4 – <i>Social and perceptions</i> 7 – <i>Planning</i> 8 – <i>Implementation</i>
How did you plan and implement green construction on SHSD projects?	7 – <i>Planning</i> 8 – <i>Implementation</i>
How would you rate and motivate your experience in planning and implementation of green construction?	1 – <i>Knowledge and experience</i> 7 – <i>Planning</i> 8 – <i>Implementation</i>
How would you rate and motivate your knowledge in respect to planning and implementation for greening?	1 – <i>Knowledge and experience</i> 7 – <i>Planning</i> 8 – <i>Implementation</i>
Do you think 'going green' increased building costs SHSD? Please motivate.	4 – <i>Social and perceptions</i> 5 – <i>Economic and financial</i>
Did you implement green construction practices on your current projects? If not, why not?	8 – <i>Implementation</i> 9 – <i>Challenges and barriers</i> 10 – <i>Motivations and drivers</i>
When implementing greening on SHSD projects, what did you take into consideration?	4 – <i>Social and perceptions</i> 5 – <i>Economic</i> 6 – <i>Environmental</i> 11 – <i>Value creation</i>
What would motivate you to implement greening more vigorously in your HSD?	10 – <i>Motivations and drivers</i> 11 – <i>Value creation</i>
When researching green construction practices on SHSD, what sources of information do you use?	2 – <i>Policy and regulations</i> 3 – <i>Procurement</i>
How useful do you think these sources are?	3 – <i>Procurement</i> 9 – <i>Challenges and barriers</i>
Do you find or experience limitations within the	3 – <i>Procurement</i>

information sources currently available?	9 – <i>Challenges and barriers</i>
What do you currently consider as best practices regarding green construction in HSD?	12 – <i>Best practices</i>
What, in your opinion were the costs implications of green construction on the SHSD?	5 – <i>Economic and financial</i>
Did all stakeholders on SHSD projects have consensus regarding the cost implications of 'going green'? Please motivate.	1 – <i>Knowledge and experience</i> 4 – <i>Social and perceptions</i> 5 – <i>Economic and financial</i>
In your opinion, do various stakeholders shy away from greening due to a perception of increased cost?	4 – <i>Social and perceptions</i> 5 – <i>Economic and financial</i> 9 – <i>Challenges and barriers</i>
Were all stakeholders involved in SHSD projects well informed of the costs involved when 'going green'?	1 – <i>Knowledge and experience</i> 5 – <i>Economic and financial</i>

Source: Greyling (2017: Author's own compilation)

4.6.1 Theme 1 – Knowledge and experience among stakeholders

The above theme is about the knowledge and experience of the various stakeholders regarding green construction in sustainable human settlements. The questions assess the level of knowledge and experience for various stakeholders specifically relating to the planning and implementation of greening strategies in housing developments.

The majority of respondents rated their own knowledge and experience, in terms of planning and implementation of green construction practices in SHS, as limited. From responses it was clear that knowledge and experience was even more limited among participants in the Free State province, when compared with participants in the Gauteng province. Many participants in the Free State reported that they had not previously or on current project been exposed to greening. Some participants in Gauteng have also not dealt with greening on previous projects and have only been exposed to it on the current projects that they are involved in.

It emerged that Cosmo City was one of the very first integrated human settlement developments in South Africa and consequently, the experience among stakeholders with regard to greening was practically nil. It appeared from interviewee responses that, knowledge regarding the planning and implementation of greening on construction projects was higher when compared to housing projects only.

One of the participants emphasized that they would rather appoint knowledgeable people in the area of greening. Another participant highlighted that inputs from various project participants adds to the overall knowledge base. From responses it emerged that there is also a need for end-user (beneficiary) and community education.

Respondents had various opinions regarding information sources that are currently available in terms of greening in SHS. Some respondents were in agreement that most suppliers are concerned, principally with marketing their specific product and can provide little information on technical aspects regarding their product. This can be seen from the typical response: "Suppliers mostly do selling and do not have product knowledge, detailed technical knowledge is lacking." Respondents listed the following sources that they would use: internet, speaking with other consultants, suppliers, sub-contractors, practical visits of similar projects, CSIR, DHS, GBCSA and proven technologies.

Limitations within the current information sources were also discussed. Respondents were in agreement that the information does exist, however the visibility of the information is limited. A summary of the responses to this theme are illustrated in Figure 24 below.

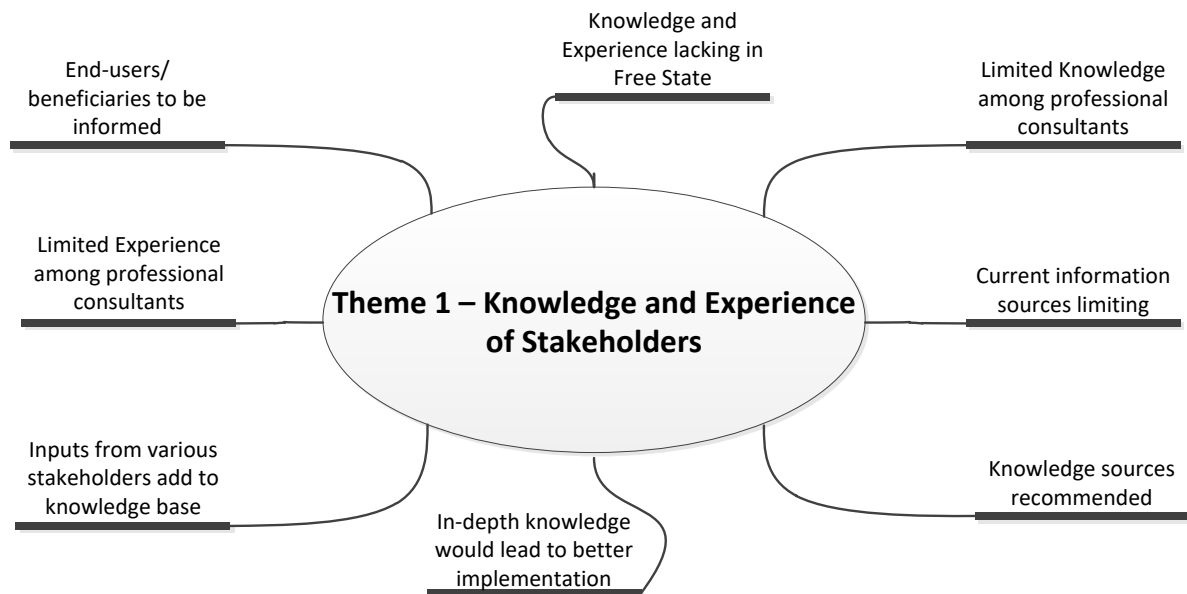


Figure 24: Summary of responses relating to knowledge and experience among stakeholders

Source: Greyling (2016: Author's own compilation)

The findings captured under this theme suggest that there is still to a large extent limited knowledge among SHS stakeholders of green construction practices within SHS. This suggests that information should be made more visible to all stakeholders and this should happen on a variety of forums. There is also a great need for improved information sources and it may be suggested that there is need and opportunity within the SHS industry to provide quality information to stakeholders. It was also emphasised that stakeholders have had very little experience with green construction practices within SHS and this should become increasingly better as industry is shifting towards green construction strategies.

4.6.2 Theme 2 – Policy and regulations in sustainable human settlements

This theme covers aspects involving government policy and regulations that govern SHSD. It also includes inputs from government in terms of financing and grants.

Many respondents emphasized that government has a major role to play in determining the extent and success of greening within SHS. One of the respondents commented the following: "Government must make a policy, because policies lead to mandates, which are enforceable". There was a general consensus among

participants that the DHS wants to go green, however the current housing subsidies do not include a budget for greening.

From respondents, it was affirmed that the Cosmo City project was done on behalf of the provincial government and that no greening implementation was required. It was also noted that it was not included during the planning phase. From respondents it came to light that subsequent subsidies and grants allowed for some greening of the Cosmo City project. It was indicated that 'going green' is not really a choice any longer as it has been legislated. It is suggested by respondents that the specifications for greening are comprehensive, but are not implemented. Respondents also noted that a lack of education among certain stakeholders, such as building inspectors, led to the signing off of projects, which are sub-par, which was stated to have an effect on the entire process.

It emerged from responses that the SANS10400 is currently used in SHS. The study established that the pitfalls lie in the implementation phase and it was stated: "Municipal departments are involved in implementing the SANS10400, however the level of implementation is dependent on the officials involved". Some participants expressed that contractors may be able to make suggestions to government. However, since projects are not currently out on tender (government makes use of a supplier database), which rarely happens. The contributions in terms of this theme are summarized in Figure 25.

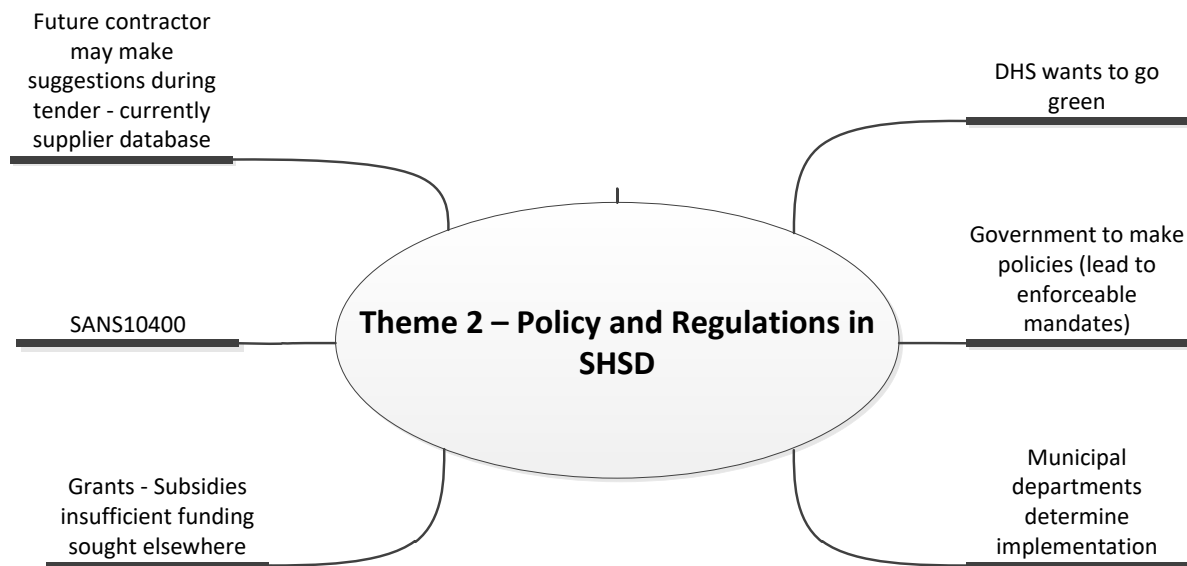


Figure 25: Summary of responses relating to policy and regulations in SHS

Source: Greyling (2016: Author's own compilation)

A variety of discoveries revealed during the literature study supports these findings. The South African Housing Act (Act 107 of 1997) and The South African National Housing Code (2009) are indicative that the South African government wants to implement greening strategies within SHS. The LGTAS (COGTA, 2009) supports the involvement of municipal departments within the implementation of service and housing.

From the above responses, it may be suggested that current government policies and regulations are insufficient in assuring the implementation of greening strategies in SHS. This may be attributed to unawareness of stakeholders, other than government, specifically referring to the SANS10400, which many interviewees were not familiar with. There also seems to be a lack of vigorous government involvement, which mainly attributed to municipal or local government spheres, where implementation is of concern. This lack of vigorous implementation may be a result of being uninformed of the need for greening strategies within SHS and/or a lack of capacity to ensure proper implementation.

4.6.3 Theme 3 – Procurement of project materials and services

In this theme, various aspects relating to the procurement of materials and services are dissected. This theme also takes into account professional services, sub-contractor services and suppliers of products and materials used during construction.

There was consensus among respondents that the only greening that is taking place on the majority of projects, is the use of solar geysers. It was found that all respondents were currently using normal/traditional construction materials and no reference was made to any greening in terms of construction materials.

Some respondents stated that developers receive information from approximately 150 suppliers a week and that all this information has to be evaluated. There was consensus from respondents that these sources were not deemed particularly useful and that it is of concern that, there is currently no method of really measuring quality among various suppliers. From interviewee responses it was also noted that an additional concern was, that agreement certificates are all approved and that the market is flooded with products.

Respondents were in agreement that there is a problem with many products in which the processes are mechanized, because that has labour implications. It was argued that labour-intensive practices go hand-in-hand with community upliftment, which is one of the ultimate aims of sustainable human settlement development.

It emerged that some professionals in the industry are charging increased professional fees on green projects. It was also revealed that respondents agreed that current concepts regarding green construction in SHS are good, however the practical implementation and sustainability of the concepts are questioned. Viewpoints in accordance with this theme are summarized in Figure 26 below.

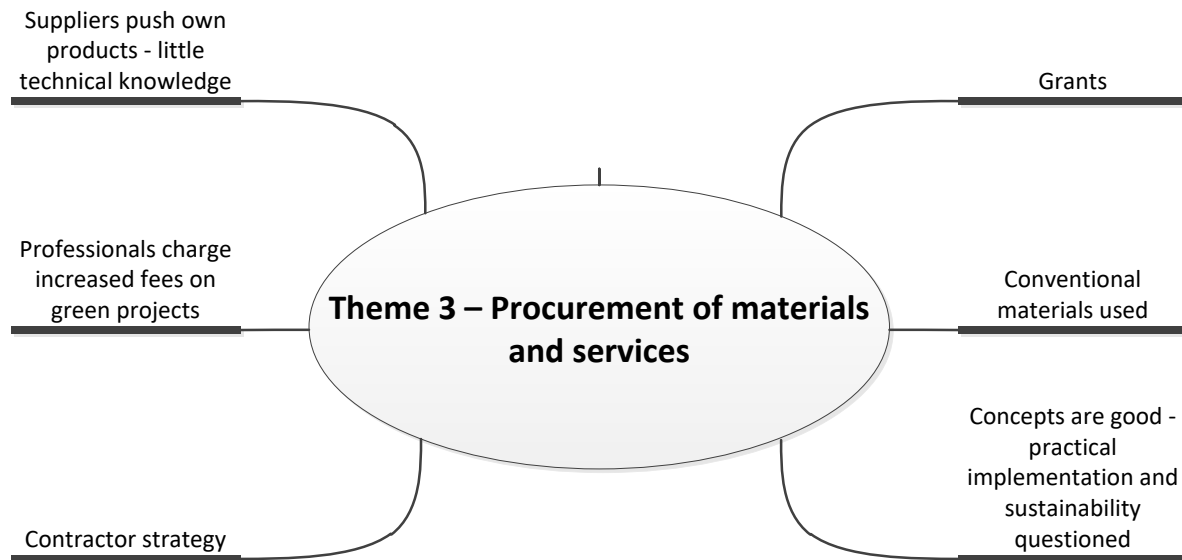


Figure 26: Summary of responses relating to procurement of materials and services

Source: Greyling (2016: Author's own compilation)

Deductions could be made from the above theme and are subsequently discussed. Currently there is limited application of green construction principles in terms of material sourcing. This may be attributed to the perceptions that the costs are higher. It is also posed that suppliers simply push their own products and there seems to be a need within the industry for specific role-players (such as councils and associations), to provide knowledge of products, without supplier bias. The contractors also have some ability to influence the procurement practices in favour of green materials and products, however this seems to be rarely done.

4.6.4 Theme 4 – Social factors and perceptions in sustainable human settlements

In this theme various perceptions, specifically regarding social aspects in SHS are discussed. The focus of this theme is on the perceptions of and impacts on the beneficiaries of SHS.

Respondents were in agreement that communities should be approached for their inputs in SHS. It was found that there is a lack of education among beneficiaries regarding green construction and the benefits inherent to them. It emerged that beneficiaries do not want social housing, which was supported by the statement:

“they (the beneficiaries) literally run away when they see that they have been awarded units in social housing”. The study established that there needs to be a change in the perceptions of beneficiaries of subsidized housing. They need to view it as gaining an asset. It was confirmed by some respondents that decisions to implement green strategies on a project are dependent on the end-use perceptions and that end-user perceptions receives some consideration.

It also emerged that there are questions that, should greening be implemented in SHS and the units are then sold or rented, would the end-users be able to afford the higher premium that a green unit would be charged. It emerged that there is a perception in the industry that green construction reduces the use of labour, and that the DHS is vested in providing job opportunities and that this may be the conflict which leads to the lack of implementation of green construction in SHS. The participants’ perceptions in terms of social influences are summarised in Figure 27.

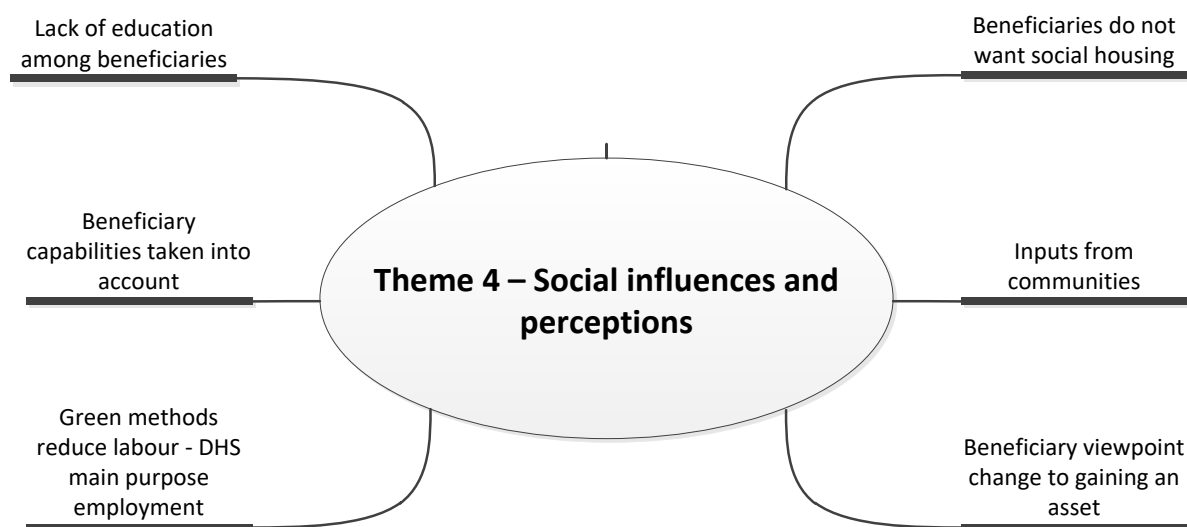


Figure 27: Summary of responses in terms of social influence and perceptions

Source: Greyling (2016: Author’s own compilation)

The above theme prompted the following discussions. There is a lack of education among beneficiaries regarding green construction within SHS. This should be addressed; however, the correct forums are to be established. It was also highlighted that the communities should be provided an opportunity for inputs in terms of the development of new SHS projects. Community involvement should also be

encouraged in terms of job creation and contractors are to make use of labour intensive practices, whilst still using green construction practices, to ensure community upliftment.

4.6.5 Theme 5 – Economic factors and perceptions in sustainable human settlements

This theme exposes the perceptions among stakeholders regarding high costs in terms of the implementation of greening in construction-related projects.

There was a general feeling that the costs involved in green construction is higher than conventional construction. This can be seen by the typical interviewee response: “There is definitely a financial implication, specifically solar geysers cost more than normal geysers”. Respondents also emphasized that the higher subsidy quantum on SHS is proof that green construction is more expensive. One respondent commented that greening increases total development costs by between 15 – 20%. Respondents confirmed that the installation of certain greening strategies, such as solar geysers, glazing and insulation, does in fact add to the project costs. It emerged that the subsidies on projects such as Savanna City were increased from R68,000.00 to R110,000.00 specifically to allow for greening.

From interviewee responses, it became clear that the financial implications are the main consideration in the decision to go green on a development. This can be evidenced from typical interviewee response: “As is stands currently greening is more expensive when compared with traditional building methods and materials”. It was also noted that the provincial government was the financier on the Savanna City project and that the decision to implement greening was based on the additional allowances from the financier. It was emphasized that sustainability revolves around economies and not around greening.

From interviewees it was suggested that capital investments need to be compared to the possible savings that may be gained from green installations. It also emerged that professional fees are also increased as some professionals load their fees on green construction projects, contributing this increase to additional services. It was

stated by respondents that there was consensus among all project stakeholders regarding the cost implications of going green and it was proposed that the fact that the provincial government increased the subsidy amount is evidence that even they are in agreement.

Some respondents stated that stakeholders do not shy away from greening as there is a realization that it must be made to work. It was also reasoned by respondents that stakeholders should see greening strategies as part of the development costs. From responses, specifically relating to the Savanna City project, it was revealed that quantity Surveyors were urged to become creative when catering for sustainable development, specifically in terms of economic implications.

It was found that there is a perception that an increased demand in green developments would reduce the costs of green construction. The study established that LCC is to be included for the initial capital outlay to be justified.

Other revelations from the study include that there are passive green principles that may be implemented in SHS that do not contribute to the costs. However, the majority of participants vigorously stated that there is simply no money for implementing green construction in SHS. It was also found that the gap market (FLISP) is under-utilized and that funding is available, however people must tap into it. The perceptions of participants' in terms of this theme are summarized in Figure 28 below.

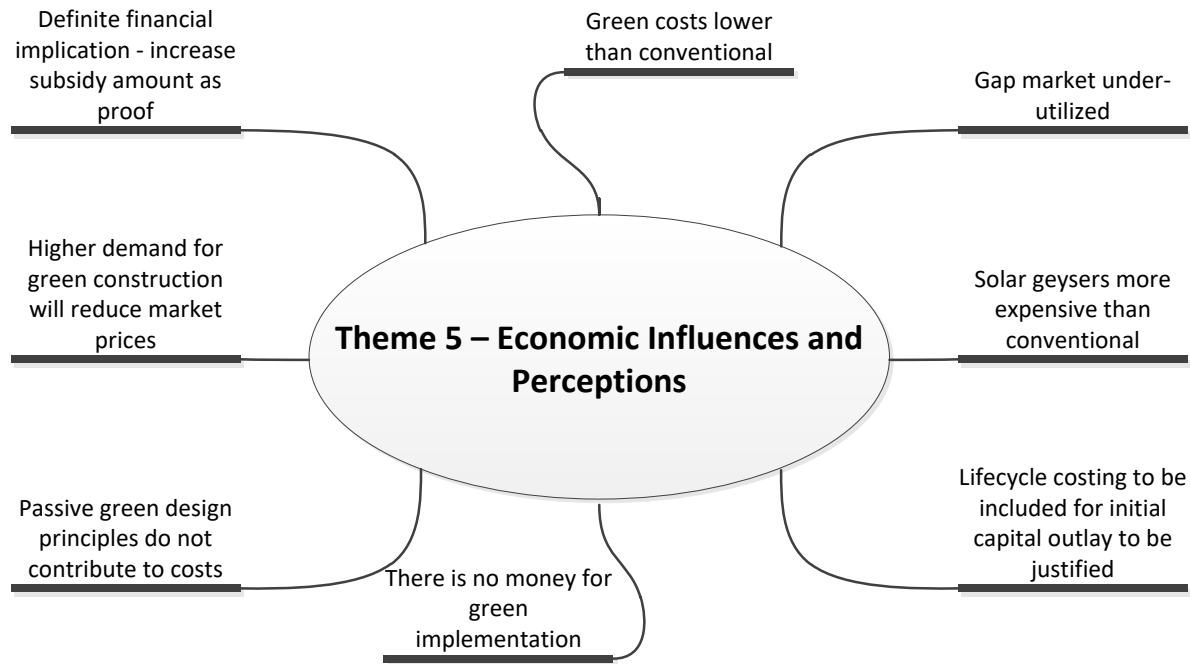


Figure 28: Summary of responses in terms of perceptions of economic influences

Source: Greyling (2016: Author's own compilation)

Many issues are addressed in the above theme and requires some discussion. It seems that financial resources currently govern the implementation of green strategies in SHS. Government should consider increasing the subsidy quantum to specifically allow for greening strategies. There is a need for professionals to become involved in ensuring the implementation of green construction practices within SHS. Designers are to become involved in implementing design principles that have little implication on the project costs. Quantity surveyors (or other estimating parties), should become informed of lifecycle costing and should implement this on projects and present it to the clients/decision-makers to justify the initial capital outlay required for greening strategies within SHS.

4.6.6 Theme 6 – Environmental factors and perceptions in sustainable human settlements

This theme focuses specifically on environmental factors in SHS. It also looks at perceptions of various stakeholders in terms of the environment.

From responses, it emerged that consensus exists that green construction is viewed as a good idea. This may be evidenced by interviewee response: “We need environmental protection”. It was found that respondents agreed that there was scientific evidence to prove that green construction should be seen as a priority. However, it was also noted by respondents, that there was a certain hype regarding greening that have taken people by storm.

There was a general agreement that there is high pressure on the national electrical grid and some severe measures need to be taken in order to manage the increasing electricity demands. The study revealed that respondents were considering other alternative power sources, including gas and wind. This was promoted by a respondent stating: “We should consider wind generated electricity, especially in the Bloemfontein area, maybe on Naval Hill or outside of Bloemfontein”.

Respondents revealed that greening was implemented on the Cosmo City project to a very limited extent, but was included in the Savanna City project. Many respondents, especially those active in the Gauteng Province, revealed that most environmental measures taken in SHS, included the provision of green areas, such as trees, parks, cycling and pedestrian lanes. It became evident that besides solar geysers, very few measures considered green construction practices. A summary of replies to this theme are recorded in Figure 29.

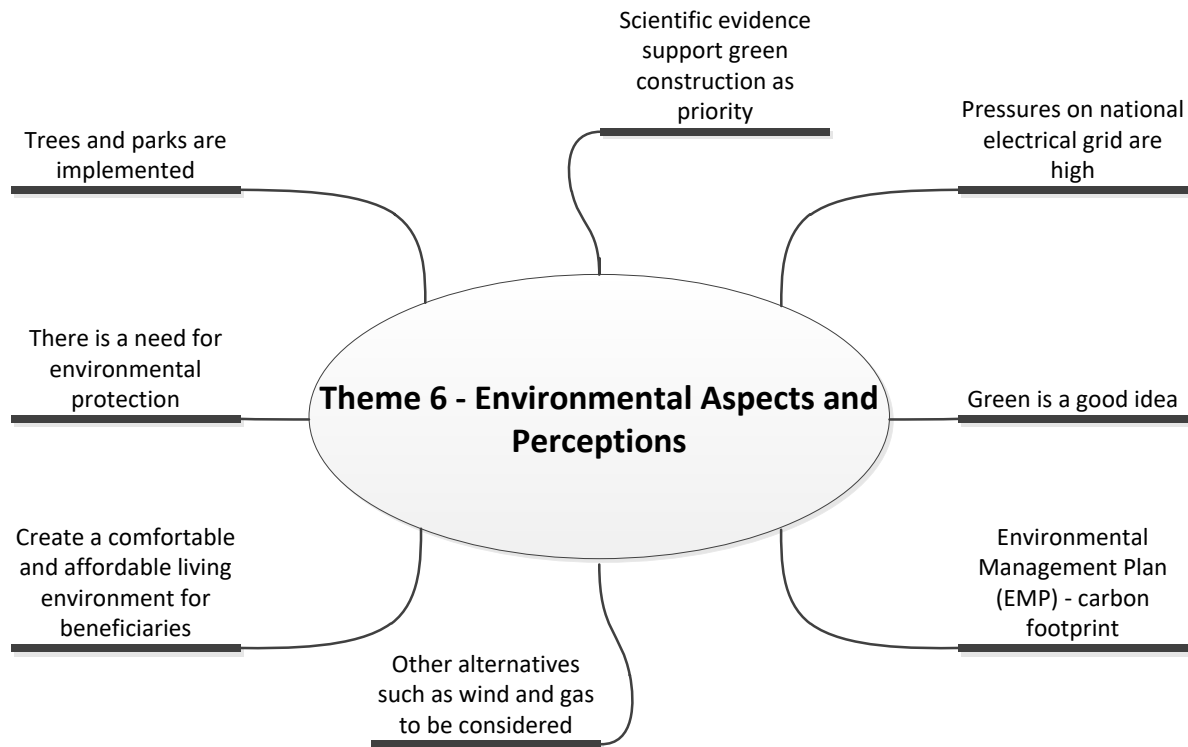


Figure 29: Summary of responses in terms of perceptions of environmental aspects

Source: Greyling (2016: Author's own compilation)

The following discussions flow from the findings in the above theme. It seems that there is some consensus within the industry that greening is seen and a good idea. This is supported by numerous literature sources that recorded scientific evidence such as St. Clair (2011). There is base knowledge on the fact that green construction is necessary and that there is a need for environmental protection. This is affirmed by the literature (Kibert, 2016), which lists the protection of nature and one of the principles of sustainable construction.

4.6.7 Theme 7 – Planning of sustainable human settlements

This theme emerged to capture opinions and suggestions regarding the planning of SHS.

The study revealed that the general feeling was that planning for green construction should be included from the initiation of the project. This was stated specifically in interviewee response: "With the planning of finances for greening strategies on any

construction project, it should be included from the beginning of the project, therefore from project initiation.” It also emerged that respondents were in agreement that planning for greening in SHS needs to be pro-active. Respondents also argued that opportunity should be given early in the project for various role players to provide input. From responses it was found that the impact on the design considerations was also taken into account during planning. It was revealed that other considerations included the electrical supply, both internal and external infrastructure requirements, need to be met. Figure 30 illustrates a summary of responses to this theme.

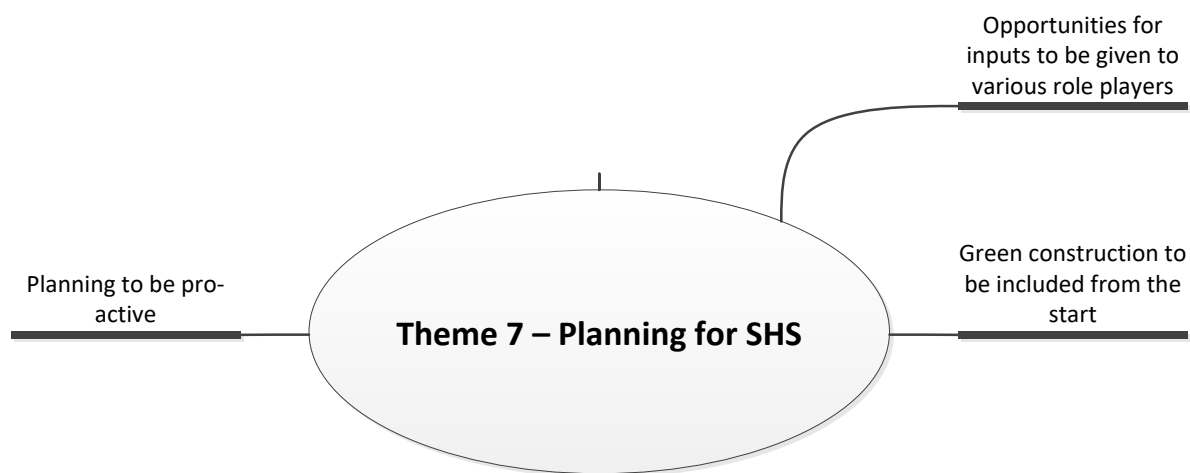


Figure 30: Summary of responses in terms of planning for SHS

Source: Greyling (2016: Author’s own compilation)

The above findings are supported by the literature study outcomes (Ihuah, Kakula and Eaton, 2014), that suggest that the project mission and goals, a competent project team, information and communication, are all considered critical success factors in ensuring SHS. From the findings it is suggested that greening strategies should be included at the conception of the planning phase of SHS and that all stakeholders should be provided opportunities to provide inputs in their areas of expertise, which may better ensure implementation and project success.

4.6.8 Theme 8 – Implementation of sustainable human settlement projects

This theme elaborates on the current implementation of green strategies in SHS and also gives an overview of the perceptions and opinions regarding implementation of SHS projects.

It was revealed that there was no implementation of green construction on the Cosmo City project. However, it was marketed as a green development. Respondents stated the following in connection: “It (greening) was not specifically planned” and “It was a collective decision between the developer and the City of Johannesburg not to implement green initiatives, as it was not well defined”. Respondents revealed that the Cosmo City Development is not green at all, as 98% of units had already been constructed and the remaining 2% designated for commercial use have applied for exemption from greening. Interviewees did affirm that Savanna City, on the other hand, is completely green.

The study revealed that the SANS10400 was implemented on the Savanna City development, but that it was not marketed as a green development. Some respondents stated that implementation of ideas was a problem. There was a general feeling that it would be of much help if the implementation was well managed by government. A respondent stated that: “The municipality mostly just approves (drawings and plans) and are not involved in the implementation”.

Respondents did speculate on some reasons for the lack of proper implementation and this included that it is not done due to ignorance or a lack of knowledge. Other respondents stated the level and success of implementation was not a choice of the contractor or the developer, but will depend on the engineers and the clients. Inputs in terms of this theme are illustrated in Figure 31.

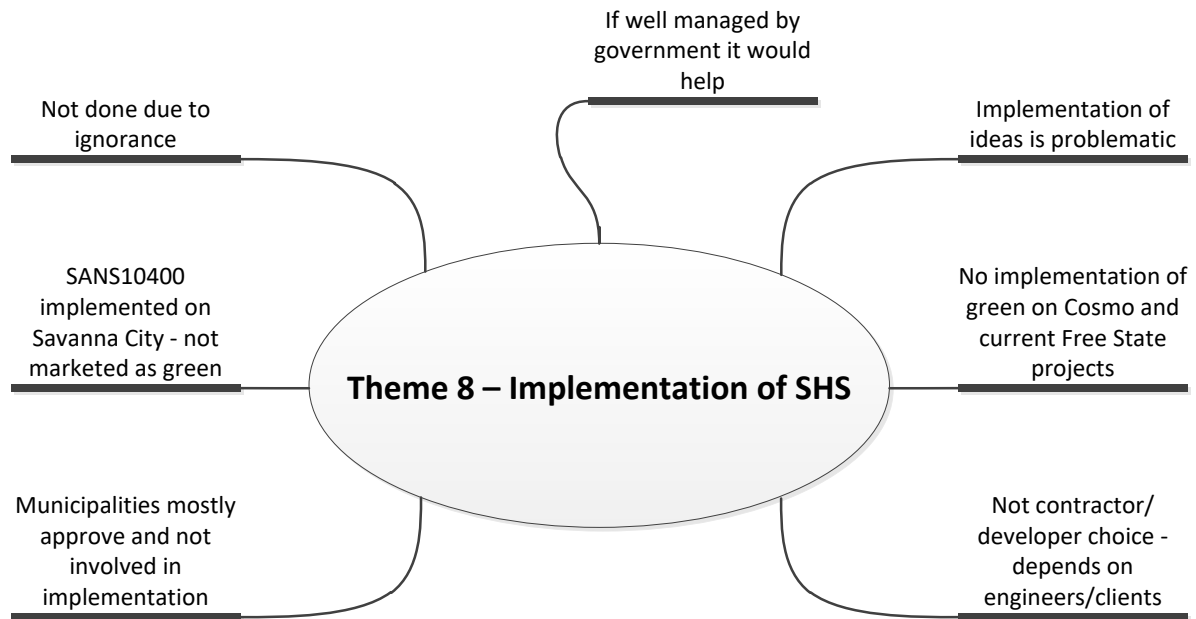


Figure 31: Summary of responses in terms of implementation of SHS

Source: Greyling (2016: Author's own compilation)

The implementation of SHS seems to be a contentious issue. As the client/project funder, the government should ensure proper implementation of greening strategies, by either assigning responsibilities within government or assigning the responsibilities to consultants or professionals outside of government. If implementation is to be improved, all stakeholders should make green construction practices within SHS, a priority within the project.

4.6.9 Theme 9 – Challenges and barriers to sustainable human settlements

This theme discusses the challenges and barriers to SHS. The challenges and barriers are given from the perceptions of a variety of stakeholders that participate in SHS delivery.

The general agreement among respondents were that budget constraints were the chief challenge/barrier. Some other respondents argued that financial challenges could be overcome by seeking funding elsewhere, but that the biggest problems were responsibility, sustainability and practicality. It was revealed that initiatives were planned and not implemented due to a lack of funding and responsibility in implementation and maintenance.

The study also revealed that a challenge faced was that beneficiaries were not interested in social housing or green initiatives. It emerged that government is looking to speed of delivery, due to an increasing housing backlog, rather than green. There was a general feeling that government was not enlightened and suggestions to remedy this, included that professionals should approach government to reveal the pros and cons of green construction to government officials.

Another challenge/barrier that emerged, was a general lack of knowledge within the industry stakeholders, as was evidence by the statement: “If knowledge was good, it (green construction) would have been implemented”. The study also revealed that limitations existed within current information sources as green is over-marketed, there is green washing among suppliers, there is a lack of integrity and visibility of information is lacking. Figure 32 below illustrates the contributions of participants in terms of this theme.

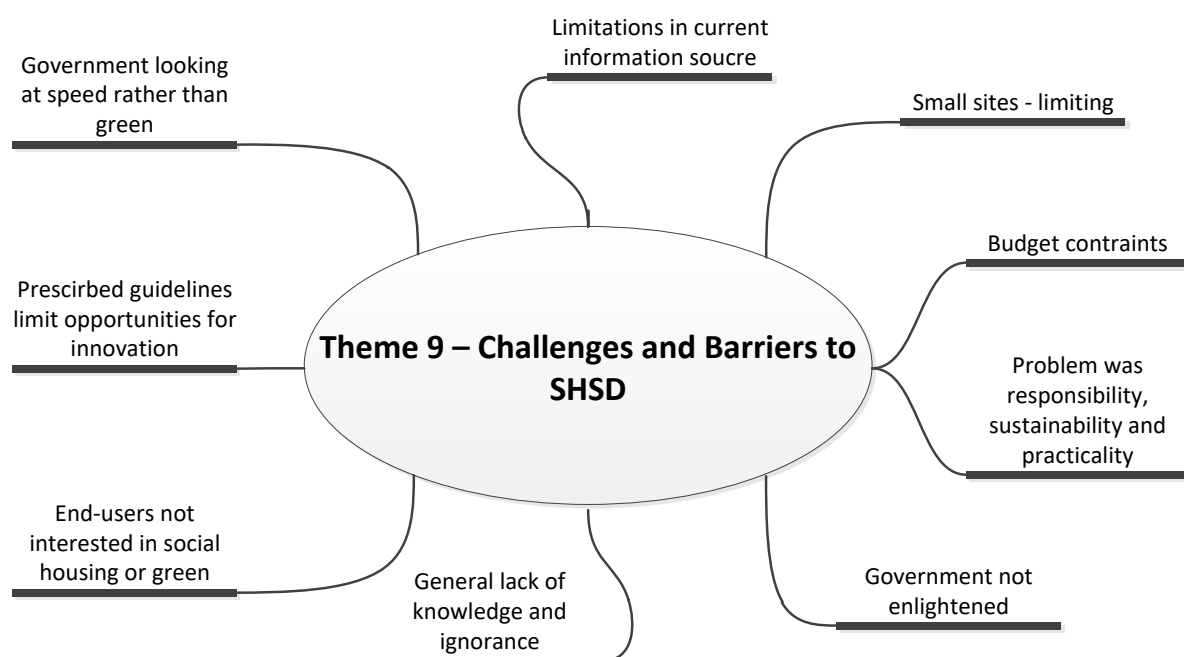


Figure 32: Summary of responses in terms of challenges and barriers to SHSD

Source: Greyling (2016: Author's own compilation)

The barriers presented during the literature study by various authors, including; Klunne (2002: 41), Ahn, Pearce, Wang and Wang (2013: 39), Hakkinen and Belloni

(2011) and WBCSD (2009: 12), correlate with the responses to the interview questions. To a large extent the barriers that emerged during the interviews were also captured in the literature review.

Barriers need to be addressed and all stakeholders should contribute to ensure that this is done. Barriers, such as stringent guidelines, requires to be addressed by designers. Other barriers, such as budget constraints are to be effectively addressed by quantity surveyors (or other estimating parties). Each of the barriers are to be addressed by parties knowledgeable in those specific areas which may ensure enhanced overcoming of barriers.

4.6.10 Theme 10 – Motivations and drivers of sustainable human settlements

This theme emphasized the motivating factors that would ensure participation by stakeholders in actively planning and implementing green construction practices in SHS. In addition, this theme also elaborated on the drivers of SHS in South Africa.

The study revealed that there were a large variety of factors that would motivate respondents. It emerged that in some cases the intent of the SHS (creation of a better living environment for beneficiaries), was a bigger motivation than cost. Other respondents stated that additional, or an increase in funding would motivate them as implementation is affected due to a lack of resources. This is evidenced by the statement: “If it becomes cheaper”. It emerged that motivations for the implementation of greening on a project included mainly the project stakeholders’ own convictions regarding carbon footprints and the benefit of marketing a development as a green development. It was also seen by respondents as motivational if the greening strategy was part of the original layout of the project.

It was also discovered that cost savings to the beneficiaries would motivate some respondents stating: “To assist beneficiaries who cannot afford service”. Savings on resources, especially electricity, was also seen as a motivating factor by some respondents. Legislation, specifically SANS10400, was also provided as a motivating factor. Another respondent cited that completed practical examples would serve as motivation.

The general consensus among respondents may be summarised by the statement: “You either want to (voluntary), or you have to (legislative), but at what cost (economic)?”. The responses of participants to this theme are illustrated in Figure 33.

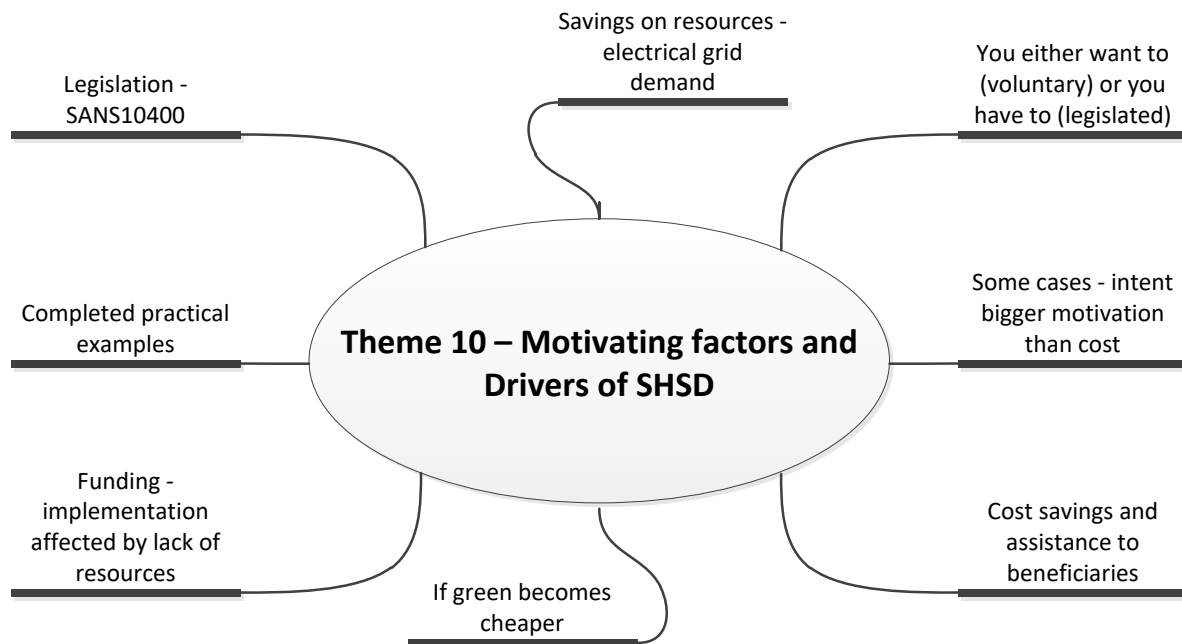


Figure 33: Summary of responses in terms of motivating factors and drivers of SHSD

Source: Greyling (2016: Author’s own compilation)

The responses in this theme agrees with the literature findings as presented by Ahn, et al. (2013) and Hakkinen and Belloni (2011), in the tables (on p.17) compiled for drivers to sustainable human settlements and for drivers to green construction respectively.

In order to ensure SHS in South Africa, which includes green construction practices, the above motivating factors and drivers should be promoted. Evidence should be provided of the achievement of the above, such as cost savings to clients, in order to motivate all stakeholders. Again, this should be addressed by specific industry experts, such as designers and quantity surveyors.

4.6.11 Theme 11 – Value creation in sustainable human settlements

This theme aims to highlight suggestions from responses towards value creation in SHS.

Responses focuses predominantly on value added to the end-users (beneficiaries) and included that beneficiary benefits were important. This included a holistically better living environment (included indoor and external conditions). It was also suggested by respondents that the electrification of the entire household should be provided, however should be designed as to reduce electricity consumption.

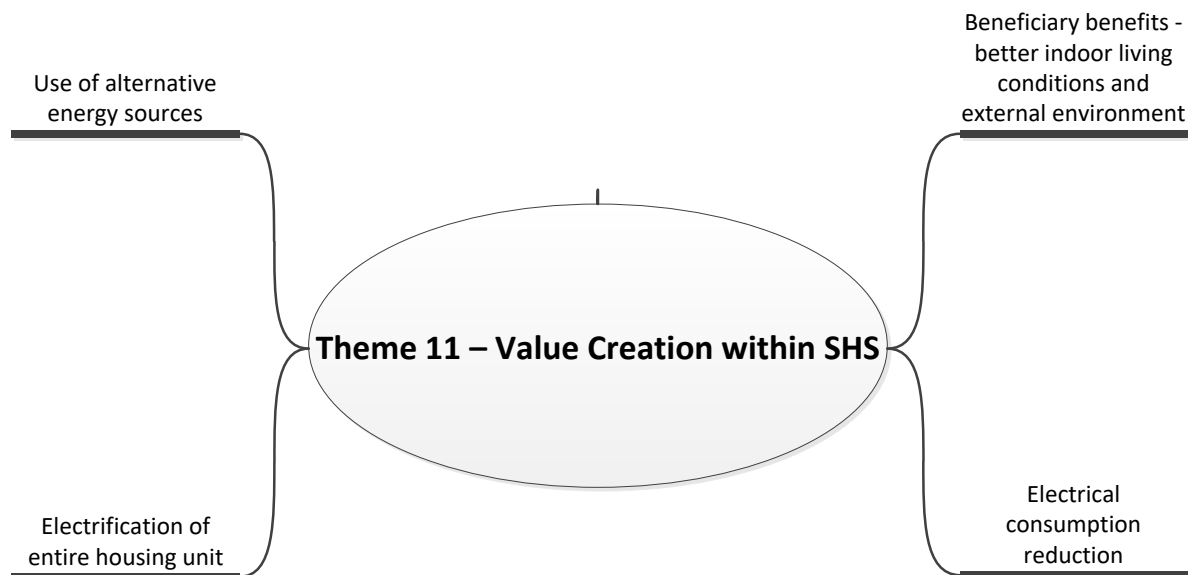


Figure 34: Summary of responses in terms of value creation within SHS

Source: Greyling (2016: Author's own compilation)

It can be gained from this theme that the requirements of the beneficiaries are seen as important by stakeholders within the industry.

4.6.12 Theme 12 – Best practices in sustainable human settlements

The theme above revolves around current best practices in terms of greening of sustainable human settlement developments.

It emerged that many respondents considered that installation of solar geysers as best practice in SHS. It was also suggested that the entire house should be transferred to solar electricity as best practice. The study also revealed that respondents considered SANS10400 as best practice and emphasised in the regulations were insulation, roof overhangs and correct orientation. It was found that rainwater harvesting was also deemed as best practice in greening of SHS.

It was advocated that passive solar design, in terms of heating and cooling, was seen as best practice. It was found that integrated housing was also seen as best practice in SHS. Some respondents considered the creation of a sustainable environment as best practice. A respondent also stated that stakeholder management, referring to proper methods, should be deemed best practice. Viewpoints of this theme are presented in Figure 35 below.

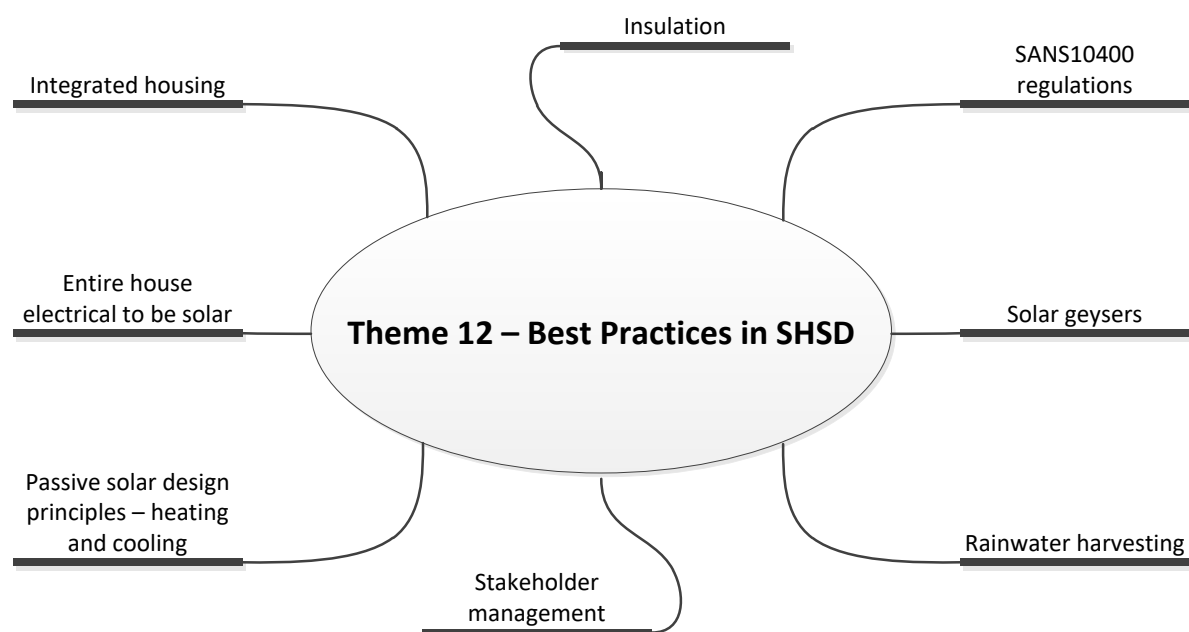


Figure 35: Summary of responses in terms of best practices in SHS

Source: Greyling (2016: Author's own compilation)

Some of the best practices listed here were recorded in various forms within the literature study. These include passive solar design (Athienitis and Santamouris, 2013 and Burton, 2010), stakeholder management, solar geysers (Kaligoriou, 2013) and integration of SHS.

The best practices recorded above should be marketed within the SHS environment. Chiefly this should be promoted to government, which are the clients/funders, and also to the end-users. Industry professionals should also be informed of current best practices to ensure that SHS within South Africa is optimal.

4.7 CROSS CASE ANALYSIS

After the collection of the various data sets, a comparison needs to be done in order to determine whether the findings correlate between the interviews conducted, the documents analysed and what the findings of the literature review were. The method used in exploring the relationships amongst qualitative data was tabling the themes and categories and examining their connections (cross-tabulation). Table 18 below indicated the relationship between the analysed interviews, documents and literature sources.

Table 18: Cross tabulation of the Cosmo City and Savanna City findings

Research Question	Exploratory Survey	Document Analysis of Cases	Interview Analysis of Cases	Outcome
SRQ 1 – What are the factors affecting the delivery of sustainable human settlements in South Africa?	<ul style="list-style-type: none"> ▪ Not applicable 	<ul style="list-style-type: none"> ▪ Integration ▪ Participation and education of end-users ▪ Socio-environmental investments ▪ Land availability ▪ Enforcement and support of guidelines by government ▪ Stakeholder 	<ul style="list-style-type: none"> ▪ Beneficiary perceptions ▪ Stakeholder experience, knowledge and involvement ▪ Government policies and management ▪ Municipal department involvement ▪ Subsidy and grant allowances ▪ Increased costs 	<i>Confirmed</i>

		involvement <ul style="list-style-type: none"> ▪ Township establishment ▪ Establishment of services infrastructure ▪ Timeframes provided ▪ Number of government departments involved ▪ Development maintenance 	and budget constraints <ul style="list-style-type: none"> ▪ Labour intensive practices sought ▪ Community involvement ▪ Innovative green Designs ▪ Life cycle costing ▪ Creation of suitable living environment ▪ Trees and parks ▪ Contractor strategy ▪ Speed of delivery ▪ Resources saving (electrical) 	
SRQ 2 – What are the perceptions of going green in the human settlement sector?	<ul style="list-style-type: none"> ▪ Increase construction costs 	<ul style="list-style-type: none"> ▪ Socio economic value added should form part of SHS 	<ul style="list-style-type: none"> ▪ Green construction increases development costs ▪ DHS wants to go green ▪ Concepts are good, however implementation and sustainability are questioned ▪ Beneficiaries (end-users) are not interested in social housing or greening 	<i>Confirmed – regarding cost perceptions</i>

			<p>strategies</p> <ul style="list-style-type: none"> ▪ Green construction practices reduce the labour requirements ▪ Green construction is a good idea ▪ There are current budget constraints ▪ Stringent guidelines limit possibilities for innovation in terms of design 	
SRQ 3 – How do the prevailing perceptions affect the execution of human settlement projects?	<ul style="list-style-type: none"> ▪ Limited implementation ▪ Paucity in green designs ▪ Inadequacy in green material specification ▪ Limited implementation of green construction practices 	<ul style="list-style-type: none"> ▪ Not applicable 	<ul style="list-style-type: none"> ▪ Green construction practices not implemented or limitedly implemented due to beneficiaries (end-user) reluctance ▪ Not implemented due as labour intensive construction practices (viewed as conventional) 	<i>Confirmed – in terms of cost perceptions and knowledge and experience</i>

			<p>are sought after</p> <ul style="list-style-type: none"> ▪ Green construction practices not implemented or limitedly implemented due to budget constraints - implemented when additional funding/grants are provided ▪ Stringent guidelines - little variance in designs of housing units 	
SRQ 4 – How should the cost concerns of going green in the human settlement sector be best tackled in South Africa?	<ul style="list-style-type: none"> ▪ Government incentives and grants ▪ Proof of cost benefits to beneficiaries (end-users) 	<ul style="list-style-type: none"> ▪ Project delays should be limited ▪ Bulk services should be subsidized 	<ul style="list-style-type: none"> ▪ Contractors to have opportunity to make suggestions to government ▪ Government to make policies, which will ensure enforcement ▪ Lifecycle costing to be included in project proposals to justify initial capital outlay 	<i>Confirmed – in terms of government incentives, project delays and cost benefits to beneficiaries (end-users)</i>

			required in SHS <ul style="list-style-type: none"> ▪ Changes to current human settlement delivery must include implementation of strategies that have limited cost implications, such as passive solar design 	
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Source: Greyling (2016: Author's own compilation)

4.8 CHAPTER SUMMARY

Chapter 4 gives an indication regarding the understood implications of going green among stakeholders. It becomes clear that stakeholders are operating in the area of sustainable human settlements, relatively and instinctively with regards to green strategies and its implementation. This is due to the fact that not many sustainable human settlements development projects have been completed in South Africa. Information regarding barriers, drivers and benefits of implementation of green strategies is limited. Chapter 5 will summarise what can be concluded from the study in terms of sustainable human settlement development and the costs involved in including greening strategies in such developments. Chapter 5 will also look at possible recommendations that can be extrapolated from the conclusions drawn.

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

Chapter 5 provides an overview of the study, summarizes the main findings from the study, answers the research hypotheses and objectives, draws conclusions and makes recommendations.

5.2 OVERVIEW OF THE STUDY

The study identified that there is an apparent lack of economic and environmental suitability considerations in the planning and implementation of low-income, sustainable human settlement developments in South Africa. It set out to answer the following question: How can the delivery of integrated human settlements be sustainable in costing terms in South Africa?

The following sub-research questions were identified:

- What are the factors affecting the delivery of sustainable human settlements in South Africa?
- What are the perceptions of going green in the human settlement sector?
- How do the prevailing perceptions affect the execution of human settlement?
- How should the cost concerns of going green in the human settlement sector be best tackled in South Africa?

The aim of the study formulated in Chapter 1 was to determine how the delivery of human settlements can be enhanced to become more sustainable in terms of costing in South Africa. To achieve it, the following objectives were pursued in the study:

- Establish the key factors affecting the delivery of sustainable human settlements in South Africa
- Determine the perceptions of going green in the human settlement sector

- Examine how perceptions of going green influence human settlement projects
- Recommend how the delivery of human settlements can become more sustainable in terms of costing

A review of the literature was undertaken and the following key issues emerged. The current South African housing provision strategy is inadequate and does not include greening strategies. The South African SHS scenario was investigated and legislation, strategies and stakeholders were identified. A variety of benefits and drivers for green construction in SHS delivery were identified and discussed. In contrast, different challenges and barriers to green construction in SHS delivery were also captured. Different costs that need to be taken into account in going green in SHS were scrutinized and categorized. It was discovered that there are researched critical success factors for SHS delivery that could inform the South African SHS delivery process.

Following up on the literature review, an empirical study was undertaken involving an exploratory survey, two case studies and face-to-face interviews to establish firstly stakeholders' perceptions in terms of the key factors affecting the delivery of SHS, secondly the perceptions of green construction on the project costs and thirdly how these perceptions influence the implementation of green construction on SHS. Finally, to make recommendations on how delivery of SHS can be more sustainable in terms of costing.

A summary of the key empirical findings are presented below.

5.3 SUMMARY OF KEY EMPIRICAL FINDINGS

The research questions were answered by the different empirical data collected. The summary of key empirical findings are recorded and compared to each research question asked.

5.3.1 Sub-research question 1: What are the factors affecting the delivery of SHS in South Africa?

From the case studies' document analysis conducted, many factors were highlighted that contribute to the successful delivery of sustainable human settlements in South Africa. These factors included, but were not limited to; integration, end-user participation and education, socio-environmental investments, beautifying, land availability, involvement of multiple government departments, enforcement and support of guidelines, number of stakeholders involved, township establishment and services and timeframes provided. The face-to-face interviews that were conducted affirmed many of the factors that emerged from the case studies' findings. There were also additional factors emphasised which included; cost consideration, procurement, employment creation, proper planning and professional consultants' knowledge and experience.

5.3.2 Sub-research question 2: What are the perceptions of going green in the human settlement sector?

This research question was specifically addressed in the exploratory survey and face-to-face interviews. The exploratory survey revealed the following perceptions: the contribution of the construction industry toward GHGE is under-estimated, the costs of green construction are over-estimated, green construction is important and should be encouraged by government, there is a lack of information regarding green construction practices. From the conducted interviews the findings from the exploratory survey were confirmed. The interviews also included additional perceptions among stakeholders that are described as follows: going green increases development costs, the DHS wants to go green, greening is a good idea, concepts are good but implementation and sustainability are questioned, beneficiaries (end-users) are not interested in green construction, green construction reduces the labour required, budget constraints limit green implementation and stringent guidelines limit innovation in design.

5.3.3 Sub-research question 3: How do the prevailing perceptions affect execution of human settlement projects?

The above research question was explicitly addressed during the face-to-face interviews conducted with various SHS stakeholders. The main perceptions as highlighted above, had the following effect on the execution of human settlement projects not implemented. Unless additional grants or funding is provided, implementation is avoided due to a lack of interest among beneficiaries (end-users), government evades implementation to ensure that labour intensive construction practices (conventional) are used and that there is currently very little variance in terms of housing unit designs.

5.3.4 Sub-research question 4: How should cost concerns of going green in the human settlement sector best be tackled in South Africa?

From the case study lessons learned and the interviewee responses, the following deductions could be drawn. These deductions comprise; contractors to make suggestions for green construction implementation, LCC to be included to justify the initial capital outlay and strategies implemented which have little cost implications, such as passive solar design principles.

5.4 CONCLUSIONS

5.4.1 Objective 1: Establish factors affecting the delivery of sustainable human settlements in South Africa

Objective 1 was achieved through the investigation of sustainable human settlement delivery in South Africa, with the help of two case study document analyses and face-to-face interviews of SHS stakeholders. The various factors that are to be taken into account in the SHS delivery process have been revealed by this study.

5.4.2 Objective 2: Determine the perceptions of going green in the human settlement sector

This objective was achieved through the document analysis and interview responses related to SHS in South Africa. The discussions have provided a breakdown of interviewees' views regarding the perceptions of going green. Overall these perceptions were found to be adequate and correlated with one another. The insights of stakeholders have been effectively disclosed in twelve (12) themes that developed.

5.4.3 Objective 3: Examine how perception of going green influence human settlement projects

Objective 3 was accomplished. The interviewees' perceptions regarding green construction practices in SHS delivery have provided a record of their experiences, which provides some valuable insights into the impacts of stakeholder perception on the successful implementation of green construction practices in SHS.

5.4.4 Objective 4: Recommend how the delivery of human settlements can become more sustainable in terms of costing

The framework, data analysis and recommendations have provided explanations on how best the problems resulting from inadequate SHS delivery can be pragmatically alleviated. The interviewees have recommended various approaches, which can be adopted, while the theoretical framework also offers a variety of supplementary tried and tested solutions. This objective was achieved and is reflected in the recommendation paragraphs 5.5.1 and 5.5.2 (on p. 131).

5.4.5 General Conclusions

The study revealed that there is an ever-growing demand for subsidized housing suggesting that the South African government needs to follow a different process of sustainable human settlement development in lieu of the current providing strategy. The need and demand for a new approach to green housing delivery in South Africa is highlighted by statistical analysis and challenges recorded by national development initiatives.

It was established that green construction forms part of sustainable development and includes 'green' practices, methods and material. The findings highlighted that a lack of knowledge, skills and/or experience regarding the cost and effective implementation of green construction practices related to human settlements, may have a negative influence on sustainable development.

It was found that internationally sustainable human settlements and green building are prioritized through the United Nations' Agenda 21 and Habitat Agenda. Developing countries, such as South Africa, should take cognizance of achieving a balance on economic, social and environmental sustainability. The study also suggests that international approaches could be utilized to transform the human settlement environment in South Africa.

The study identified that numerous barriers such as knowledge, new technologies, affordability, regulation, capacity and policies, to the effective development of sustainable South African human settlements exist. The study proposed that these barriers could be counteracted with identified drivers such as incentives, regulation, standardization and awareness.

This study refers clearly to at least seventeen (17) cost aspects regarding green construction. These costs may be grouped in five categories:

- Direct costs, which include building materials, labour and methods of construction, which proved to increase costs at least 4% of the subsidy quantum.
- Support costs, referring to policy framework, regulations, programmes, plans and government incentives and grants, were proved to be essential for implementation purposes.
- Cost of effort, which implies design, specification, township planning and changing people's perceptions, requires that information should be distributed efficiently.
- Life cycle costs, including replacement values, maintenance and recyclability, needs to be taken into account when assessing "green" buildings.

- Opportunity cost entails socio-economic benefits, which include improved quality of life, job opportunities (as a result of new technology) and functional sustainable human settlements.

It was found that ignorance or lack of knowledge regarding the total costs of going green still exists amongst designers and implementers. Most are of the opinion that the direct cost of the building will be higher. However, the direct and indirect cost benefits of green building practices directly relate to sustainable developments. If the cost of effort is compared, the life cycle cost of the building and the social and environmental cost benefits. The long-term cost effect will eliminate the initial capital cost.

A variety of assessment methods for sustainable green building are shared in this study; these include pre-Brundtland and LCA. The study uncovered that the cost benefits for the end-user, the government and the nation as a whole, are hidden in the awareness and commitment of all stakeholders towards green construction.

The study indicated that the evolution of green building materials, practices and procedures is inevitable and that the construction industry is largely reliant on the professionals to implement this process. It was also established that an information gap still exists and that not all construction industry participants are aware of the actual state of affairs. It was proposed that ignorance and knowledge gaps still exist amongst designers, developers and implementers. It was found that not all construction industry participants are well informed on green construction practices. It was also suggested that new economic opportunities stimulate markets and product development.

From the study, it emerged that South African legislation, policies and strategies should translate principles for sustainable human settlements development, including green construction, into practical programmes and possible projects. The study found that to motivate designers and implementers incentives for green construction could be considered. The study established that clearly defined structures and mechanisms are promoted and communicated by the South African Government. Although a shared policy framework internationally and nationally guides sustainable

development is revealed in this study, it became evident that without effective governance, the implementation of sustainable settlement development will remain weak.

5.5 RECOMMENDATIONS

5.5.1 Recommendation for policy

From the study undertaken, the following recommendations for policy are made:

- Awareness needs to be created and promoted in the construction industry regarding green building options, influences, cost and the importance of taking action.
- Clear governmentally enforceable environmental building frameworks should include guidelines, programmes and implementation plans.
- Incentives and grants may be an option.
- Environmentally friendly awareness programmes will be beneficial to promoting greening aspects.

5.5.2 Recommendation for practice

From the study embarked on, the following recommendations for practice are made:

- Building professionals stand to make a contribution to the current climate crisis by using their knowledge regarding design, materials, practices and costs to implement and improve current standards regarding greening in low-cost human settlement developments.
- The different motivational elements for professionals should be taken into account and appropriately employed in order to create more involvement from professionals regarding “green” buildings.
- Continuous professional development is essential for informing “green” designs and specifications.
- Continuous assessment of existing buildings should be exercised to inform retrofitting strategies.

5.6 AREAS FOR FURTHER RESEARCH

The following areas for future research are recommended:

- More extensive study using statistical analysis be under taken to investigate the actual costs versus green construction costs relating to SHS.
- A study using a wider sample and/or more case studies be undertaken.
- The aspect of government officials' perceptions was not examined in the present study; further research is needed to establish or examine how government officials' perceptions affect SHS.

5.7 LIMITATIONS OF THE STUDY

Limitations experienced during this study, specifically related to empirical efforts, included:

- Some interviews conducted were not recorded, as technical difficulties occurred and were textually recorded.
- Some interviewees preferred to respond to the interview questions in their native language (Afrikaans) and these interview responses had to be translated.
- Various government officials that were approached did not want to be interviewed.

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ANNEXURE A: COPY OF COVERING LETTER

Date

Cameron Greyling
Student: M.Sc. Quantity Surveying
Department of Quantity Surveying and Construction Management
University of the Free State

Dear **Interviewee**:

My name is Cameron Greyling, and I am Master's student at the University of the Free State (UFS) currently investigating the costs involved in providing environmentally friendly sustainable human settlement developments in South Africa. As a typical example of a sustainable integrated human settlement development, the Cosmo City and Savanna City Developments have been identified as the focus of my case study.

I am writing to invite you to participate in an interview to document the development, costs involved, challenges faced and lessons learned on the Sustainable Human Settlement Developments with specific reference to sustainability and 'greening' approaches that were followed. You were identified as a prominent stakeholder that is knowledgeable of SHSD. The majority of interviews will be conducted at the place of the interviewee's choosing. The semi-structured interviews may take between 30 minutes and one hour to complete. The interviews will be recorded digitally and interviewees may be provided with paper copies of the final transcripts.

The interviews are scheduled to take place during the last few weeks of November 2016.

I sincerely hope that you will consider participating in this important effort to document the sustainable development and 'greening' approaches implemented SHSD. I will be contacting you via telephone or email in the near future to confirm your interest in being interviewed. Please feel free to contact me as specified below with any questions.

I trust that you will find this in order.

Sincerely,

Cameron Greyling
Student: M.Sc. Quantity Surveying
Department of Quantity Surveying and Construction Management
University of the Free State

PO Box 13288
Northridge
Bloemfontein
9302

Email: cameron18@live.co.za
Cell: 078 803 2376

Study Leader: Prof. Kahilo Kajimo-Shakantu
Head of Department: Department of Quantity Surveying and Construction Management
Tel: 051 401 3322

ANNEXURE B: QUESTIONNAIRE

Questionnaire

June 2011

Name:

Age:

Occupation:

Years' experience:

1. According to your knowledge, how much do buildings (during construction and their operation) contribute to the global greenhouse gas emissions? (Mark with an X)

0-10%	11-20%	21-30%	31-40%	41-50%	51-60%	61-70%	71-80%	81-90%	91-100%

2. Do you think greening will increase building costs? (Mark with an X)

Yes	No

3. By how much do you think the building costs will increase by? (Mark with an X)

0-10%	11-20%	21-30%	31-40%	41-50%	51-60%	61-70%	71-80%	81-90%	91-100%

4. Do you think that green building is an important practice that should be encouraged by the South African Government? (Mark with an X)

Yes	No

5. How often do you actively participate in making a project/building/development more environmentally friendly? (Mark with an X)

1 (Never)	2 (Almost never)	3 (Sometimes)	4 (Almost always)	5 (Always)

6. How often do you design, specify, purchase or build with environmentally friendly materials? (Mark with an X)

1 (Never)	2 (Almost never)	3 (Sometimes)	4 (Almost always)	5 (Always)

7. How would you rate your knowledge regarding environmentally friendly or energy efficient materials, practices and procedures? (Mark with an X)

1 (None)	2 (Limited)	3 (Average)	4 (Sufficient)	5 (Good)

8. What will most likely encourage you to participate in the green building process? (Mark one or more with an X)

	Government grants
	Financial Rewards
	Award
	Builder/development recognition
	Media Exposure
	Other (please specify below)

9. Do you think there is a need for information regarding green building? (Mark with an X)

Yes	No

10. Please rank the following green building subjects in order of their importance to you? (Mark with an X)

(5 - Most Important; 1 - Least Important)

	Energy efficiency (utilizing alternative energy sources and highly insulating materials, optimizing energy performance through site planning and building design)
	Resources and materials (use of recycled and/or regional materials in structure, storage and collection of recyclables)
	Indoor environmental quality (Increased ventilation, low-emitting materials, daylight and views)
	Water conservation (water use reduction through appliances and faucets, grey water re-use, low-water landscaping)
	Sustainable site planning (site selection, mixed use, alternative transportation, development density and community connectivity)

Thank you for your input!

ANNEXURE C: INTERVIEW PROTOCOL



September 2014

Questionnaire – Sustainable Human Settlement Development – The cost of going “Green”

Name and Surname:	<input type="text"/>
Occupation:	<input type="text"/>
Years' Experience:	<input type="text"/>

Good day,

My name is Cameron Greyling, and I am Master's student at the University of the Free State (UFS) currently investigating the costs involved in providing environmentally friendly sustainable human settlement developments in South Africa.

I am writing to invite you to participate in a questionnaire to document the development, costs involved, challenges faced and lessons learned on your current human settlement developments with specific reference to sustainability and 'greening' approaches that were followed. You were identified as a prominent stakeholder that is knowledgeable in the field of human settlement development.

I sincerely hope that you will consider participating in this important effort to document the sustainable development and 'greening' approaches implemented on current human settlement developments.

Please feel free to contact me as specified below with any questions. Please return the questionnaire via e-mail: cameron18@live.co.za or fax: 086 263 5893. I trust that you will find this in order.

Friendly Regards

.....
Cameron Greyling

Student: M.Sc. Quantity Surveying
Department of Quantity Surveying and Construction Management
University of the Free State

Email: cameron18@live.co.za
Cell: 078 803 2376

Study Leader: Prof. Kahilu Kajimo-Shakantu
Head of Department: Department of Quantity Surveying and Construction Management
Tel: 051 401 3322

Hypothesis 1: Limited experience and knowledge among investors, developers and policy makers leads to poor planning and implementation of green construction in Human Settlement Developments (HSD, including Housing).

1.1 What is your opinion regarding the planning and implementation of green construction on the Cosmo City Project?

1.2 How did you plan and implement green construction on the Cosmo City Project?

1.3 How would you rate and motivate your experience in planning and implementation of green construction?

1.4 How would you rate and motivate your knowledge in respect to planning and implementation for greening?

Hypothesis 2: The perception of high costs associated to green construction contributes to the reluctance by stakeholders to integrate green building principles in Human Settlement Development projects.

2.1 Do you think 'going green' increased building costs on the Cosmo City Project? Please motivate.

2.2 Did you implement green construction practices on the Cosmo City Project and in your current projects? If not, why not?

2.3 When implementing greening on the Cosmo City Project, what did you take into consideration?

2.4 What would motivate you to implement greening more vigorously in your HSD?

Hypothesis 3: There are no agreed-upon best practices in green construction in Human Settlement Development.

3.1 When researching green construction practices on the Cosmo City Project, what sources of information do you use?

3.2 How useful do you think these sources are?

3.3 Do you find or experience limitations within the information sources currently available?

3.4 What do you currently consider as best practices regarding green construction in HSD?

Hypothesis 4: The understanding of the implications of green construction costs among stakeholders differs.

4.1 What, in your opinion were the costs implications of green construction on the Cosmo City Project?

4.2 Did all stakeholders on the Cosmo City Project have consensus regarding the cost implications of 'going green'? Please motivate.

4.3 In your opinion, do various stakeholders shy away from greening due to a perception of increased cost?

4.4 Were all stakeholders involved in the Cosmo City Project well informed of the costs involved when 'going green'?

Thank you for your input!

ANNEXURE D: LIST OF PARTICIPANTS INTERVIEWED

Number	Name and Surname	Name of Firm	Occupation
1	D. Piek	Basil Read Holdings Limited	Development Director
2	J. Pieterse	Basil Read Holdings Limited	Property Development Manager
3	A. De Lange		Architect
4	L. Groenewald	Urban Dynamics	Town Planner
5	J. Janse van Rensburg	Calgro M3	Project Manager
6	O. Kapa	NHBRC	Senior Home Inspector
7	K. Prinsloo	Ruwacon	Contract Manager
8	N. Sediti	Sediti Construction	Operations Manager

ANNEXURE E: INTERVIEW TRANSCRIPTS

Interview transcript
Part A: Interviewee demographic information
Please state your name and surname, current occupation and years of experience
Interviewee 1: Davina Piek, Development Director (Basil Read), 24 years industry experience and 7 years' experience as Developments Manager.
Interviewee 2: Johann Pieterse, Property Development Manager (Basil Read), 19 years qualified, 16 years Quantity Surveying, 3 years as Developments Manager.
Interviewee 3: Adele de Lange, Architect, 16 years' experience.
Interviewee 4: Lynette Groenewald, Town Planner (Urban Landmark), 26 years' experience.
Interviewee 5: Johan Janse van Rensburg, Project Manager (Calgro M3), 7 years' experience in sustainable human settlement development.
Interviewee 6: Obasanjo Kapa, Senior Home Inspector (NHBRC), 11 years of experience.
Interviewee 7: Kobus Prinsloo, Contract Manager (Ruwacon), 23 years' experience.
Interviewee 8: Neo Sediti, Operations Manager (Sediti Construction), 12 years of experience.
Part B - Interview questions
1.1 What is your opinion regarding the planning and implementation of green construction on SHSD projects?
Interviewee 1: DHS upped specifications for greening with SANS10400 above the minimum specifications. Cosmo City: Not much. It was marketed as green initiative, but didn't really know what it meant. Savanna City: Legislation (SANS10400) in place, but not being marketed as green.
Interviewee 2: Cosmo City: The project was a project for the Province and no greening implementation was required. Subsidies granted included greening allowances. When the planning was done, greening was not yet implemented. Savanna City: SANS10400. Upped specifications from Department of Human Settlements (minimum specifications).

Interviewee 3: Budget constraints are the biggest challenge – strict prescribed guidelines on minimum requirements limit opportunities for innovation, especially greening innovation.

Interviewee 4: Cosmo City: A pro-active planning approach was followed (layout design, allocation of houses, interaction of user and agents), with opportunity for input from various role players – ‘green’ initiatives and intent was deemed very important – The mere fact that the project constituted an informal settlement upgrading is testament. Implementation of the ideas were problematic.

Interviewee 5: Calgro M3 owns land in Johannesburg, Fleurhof and state buys from them. As far as I’m concerned it is part of their planning. Solar is included in planning. Solar is expensive I would personally rather go with gas geysers. I cannot understand why they won’t implement wind turbines in Bloemfontein should be considered (on Naval Hill or outside of Bloemfontein). I think we will generate a lot if we implement that.

Interviewee 6: My opinion is that based on scientific evidence – green construction should become a priority. By priority I mean Government to make policy (which will lead to a mandate which will be enforceable) speaking to implementation of green construction. At the moment it is very little , yes solar geysers does make a difference and they are implemented The pressure is on the national grid, if you don’t start now in converting the entire house to solar right now it’s not going to work.– opt for solar electricity. Builder is a businessman, a higher market demand will reduce costs.

Interviewee 7: I know the Department of Human Settlements want to go green. They informed us that the houses should be North facing, specific windows sizes should be implemented, solar geysers should be installed, etc. Although it is not really happening because sites are small and one must look at how the house fits in. If you want to turn it North it won’t fit. A lot of times the Beneficiary have a structure at the back of the yard which they don’t want to breakdown. Our current projects only solar geysers are used, that the closest we get to green. We use normal building material otherwise.

Interviewee 8: If we look at it, it’s a good idea for the environment. It is good for the environment. We need environmental protection. Human Settlements not in the line of Green housing. The market that is available for green housing is your gap market (nurses, policemen), funds are available and people should tap into it to use it. If they tap into it you can start a green innovation project.

1.2 How did you plan and implement green construction on SHSD projects?

Interviewee 1: Water reticulation – checked thoroughly for no leakages. With SANS10400 everything is known upfront. Alternate heating – solar panels. Electrical loading is managed (houses based on load reduction). Trees and greening (parks, etc.). Environmental Management Plan to reduce carbon footprint. Greening done mostly with design aspects and not construction practices, however it's the Contractors strategy, Basil Read does not construct top structures. Cosmo City: Municipality mostly just approved, not involved in implementation. Retrofitted with solar panels, due to grant received afterwards. Parks planned and implemented. Savanna City: Municipal department involved in implementing SANS10400.

Interviewee 2: Cosmo City: Financial – Planning from the beginning. Subsidy claims are to include greening. (Pre-feasibility). Greenfields – implemented – beginning 2015. Savanna City: Mostly in terms of design. Water reticulation checked for no leakages. SANS10400 everything known upfront. Alternate heating. Electrical loading (houses based on load reduction). Trees/greening (parks). Environmental Management Plan – carbon footprint. Contractor strategy.

Interviewee 3: Must be incorporated from start. Passive green principles that do not specifically add to costs.

Interviewee 4: Cosmo City: From a town planning perspective – creating a comfortable and affordable living environment for the beneficiary group. The design was an iterative process with specific emphasis on green initiatives (community gardens, ceilings, solar units, village greens, cycle routes, variety of supportive land uses, incorporation of practical environment concepts, density, etc.). Inputs from the community, guiding government rules and policies, professionals and local authority departments and field experts.

Interviewee 5: Not applicable. There is no money for it.

Interviewee 6: In the 11 years that I've been involved with construction. – Solar has been implemented since 2007 by government. 30% of all existing subsidized houses have solar geysers that has worked out well. Solar geyser industry has become a sustainable sector and the demand has increased. In the private sector there hasn't been such a demand. Wild Olive development – solar – spin-off from government initiatives and government policy. Solar geyser is implemented, That has a good influence and the private sector can see that

solar geysers, prices are going down. Private sector are investing and buying into solar, but convert the entire house.

Interviewee 7: It is not us as the contractor or developer choice. Engineers which are appointed by the client will determine it. Although Human Settlements have their own set of specification according to which you should built. I think in the future the might suggest that contractors may come with suggestions. Some tenders currently allow for suggestions, one can price on the standard specifications or one can alternatively suggest ways of going green. However it's not yet implemented, especially in the Free State. Projects are not really go out on tender they make use of supplier database.

Interviewee 8: Not done on previous or current projects.

1.3 How would you rate and motivate your experience in planning and implementation of green construction?

Interviewee 1: Limited to Savanna City project.

Interviewee 2: Professional experience of four years, includes rainwater harvesting, factory development and insulation. Housing development – 0 – first housing. Quantity Surveying – greening in office buildings.

Interviewee 3: Ambiguous/unclear question? There are many interventions that can be implemented, but upfront consumer education is essential.

Interviewee 4: All of the above insets were received prior to the design of the development and then discussed will all on an 'ongoing' basis. Although the concepts were acceptable, there were some questions relating to the practical implementation and sustainability of some of the more detailed proposals towards greening.

Interviewee 5: Limited I Know about it and see it, but haven't done it myself.

Interviewee 6: 3 My experience (on a scale from 1 to 10). I would say 3, 30% of RDP and non-subsidized. Out of the 11 years I only have 3 years' experience.

Interviewee 7: Poor, not really exposure on projects.

Interviewee 8: Limited. Have not done previously.

1.4 How would you rate and motivate your knowledge in respect to planning and implementation for greening?

Interviewee 1: I would specifically appoint knowledgeable persons to assist with planning and implementation of greening.

Interviewee 2: Above average knowledge. In South Africa you do your homework. AS construction leader, you have to look at the facts. South African issues such as water shortages, etc. make it obvious we need to go greener. Housing development – 9 – Enough to know specifications higher than implemented. Uneducated part – Building inspector signing off – affect the whole process.

Interviewee 3: Not applicable.

Interviewee 4: Difficult to rate oneself! Had 15 years' experience at the time – access to office with many more experienced planners (we had a design workshop system). The inputs of the environmentalists, engineers, architects, government department also added to the 'knowledge base' which supported the planning and design of Cosmo City (and Malibongwe Ridge).

Interviewee 5: Limited. Note: SANS10400 sure Calgro M3 works with it, but not personally involved.

Interviewee 6: In my knowledge I will say I have 10% of what is out there. I Like to watch documentaries on green technology. Information mostly speaks to global warming and not housing specifically.

Interviewee 7: Limited.

Interviewee 8: Not so much knowledge of green. I look at aggregates that are environmentally friendly, to use less asbestos materials – mostly materials related.

2.1 Do you think 'going green' increased building costs SHSD? Please motivate.

Interviewee 1: Cosmo City: No, not implemented. Savanna City: Yes.

Interviewee 2: Savanna City: Definitely financial implication. Subsidy quantum increased, as proof. Specifically insulation and geysers. Note: Greening increases total development costs between 15 and 20%. Solar geysers, glazing, insulation – More costly. R68,000.00 subsidy

changed to R110,000.00 because of greening (Same detail).

Interviewee 3: Yes. There are numerous 'low cost' initiatives that can be implemented, but because the budgets are so tight on government subsidies housing, even these fall outside the cost margins.

Interviewee 4: Cosmo City: In some instances, yes – i.e. areas for a pedestrian and cycle lane, setting aside environmental protection zone, setting aside areas for community gardens and community facility areas which were not used. In most instances the intent (better living environment) was a bigger motivation than the costs (solar, storm water, green space, etc.).

Interviewee 5: Yes. Normal geyser R2700, solar about R10000, thus there is an R8000 difference, who will pay for that? If the state comes on board , and see that it will save money on the long run but it's a lot of money especially if you work with 48 units it is a lot of money.

Interviewee 6: No, certainly not. That is a myth, actually. Solar geysers, in 2007 The government buy solar – lessens burden on government. Spin-off now you find many townhouses are solar. When geysers break people replace it with solar rather than to fix the existing one. Knowledge is power if more people must know about it and see the benefits which will lead to an increase in demand and ultimately leading to reduction of prices. Thus it cannot increase the cost of building.

Interviewee 7: Difficult to answer because one haven't worked with costing. The initial capital investment will be more, but on the long-term it will eventually benefit beneficiaries. Due to lower maintenance and living cost on the house. If you look at a Geysers it cost R2000 versus Solar that cost R6000, it's not affecting us, the client will pay, but the owner of the house will benefit because they won't have an electrical bill.

Interviewee 8: Lot of innovative ways people use. When you use greening your cost are lower than conventional. People are not informed, so people don't have the knowledge about it. Department should do their part in changing the direction of industry in that line.

2.2 Did you implement green construction practices on your current projects? If not, why not?

Interviewee 1: Cosmo City: Project objectives included greening, however it did not happen.

Savanna City: Yes, the standard SANS10400 were implemented, however no more than that. Solar.

Interviewee 2: Savanna City: Solar geyser and insulation. Architect appointed – building plans according to SANS10400. Incorporating in Savanna City - 3 items in current specification. Different building method – “greening” advertised – never been utilized. Based on end-user perceptions. Social housing included. Note: Infrastructure may look at alternative materials (engineers). Solar streetlights too costly – won’t happen any time soon.

Interviewee 3: No. Budget constraints. For example solar/gas geysers cost ten times more than conventional electric geysers.

Interviewee 4: Yes.

Interviewee 5: No, not at all. Due to lack of funding. Calgro will suggest it, but client funding availability will determine. Current project working on prices of seven years ago. There are no funds available.

Interviewee 6: 30% of projects are being implemented, 70% not done, because of ignorance.

Interviewee 7: There are not really included in specification. We are doing the geysers thus far. We struggling to get all houses north facing to get the winter sun, and allow it to be cooler during the summer. It is difficult to position it on the sites like that due to the size of it.

Interviewee 8: Unfortunately not, the reason why we don’t implement it, we have limited knowledge. If one has in-depth knowledge it would lead to better implementation and then we can start implementing it.

2.3 When implementing greening on SHSD projects, what did you take into consideration?

Interviewee 1: Cosmo City: Not specific. Focused on environmental – larger area parks, etc. not on housing units. Note the two projects (Cosmo City and Savanna City) had different subsidy specifications. Savanna City: Alternative heating – solar panels.

Interviewee 2: Cosmo City: All budget driven. Province – Financier. Electrical supply (internal and external infrastructure). End-user perceptions. Design considerations (creative access) – Well documented. Savanna City: Alternative heating. SANS10400 (window sizes,

orientation, shading, roof overhangs, etc.)

Interviewee 3: Life time cycle needs to be incorporated for capital outlay to be justifiable.

Interviewee 4: Cosmo City: All technical aspects (affordability, practicality) such as the environmental base plan, engineering input (specifically relating to crossings, storm water, etc.), contour plan, geotechnical base plan, adjacent land uses, etc. (Red Book)

Interviewee 5: Is there money available to do it? If you sell or rent, can they afford to pay the higher rent. Beneficiaries are very poor. Unless imports become cheaper. Professionals over-charge on fees.

Interviewee 6: You have to take into consideration the items in red (on Eskom advertising grid) items such as stoves, air-conditioning, etc. Convertors capable of supplying demand – The converter should have the capability. Battery power and weather also to be taken into consideration.

Interviewee 7: Contractor don't have authority. Engineers and client determine.

Interviewee 8: Methods that other people are using it reduces labour costs because you use less people in the production process. Main purpose of Human Settlements is job employment once you implement this method job employment will be cut. Another example of others implementing it, they use moulds which enable to build those houses in a day, that will split your labour costs in halve. They don't want to go that route because it will cause community issues relating to job creation.

2.4 What would motivate you to implement greening more vigorously in your HSD?

Interviewee 1: Funding. Implementation affected by a lack of resources. Note: General entitlement – nobody works, lack of educations, and don't pay for services – Burden on municipalities, maybe start paying after eight years. Housing used as political platform to win votes. Note: Subsidy problem not going away. New generation now applying. Problem is snowballing.

Interviewee 2: Personal carbon footprint. Marketing. Has to be a part of the original layout. You either want to (voluntary) or you have to (legislative), but can you afford to (economic). Note: Subsidy problem not going away. New generation now applying. Problem is snowballing.

Interviewee 3: Providing more cost saving opportunities over the life cycle of a human settlement to its beneficiaries.

Interviewee 4: Practical examples (completed) of initiatives which were implemented that can be shown to be sustainable and affordable. Detailed building initiatives work (solar blankets, solar lights) etc. Have examples. But initiatives on a larger design scale, like community gardens, user friendly open spaces, effectiveness of conservation spaces, cycle lanes, actively used community areas (not detrimental to the environment), are not easy to come by. I.e. Lots of theories, but few examples of success stories.

Interviewee 5: If it becomes cheaper. Very little to do with implementation. Middle man costs. Import costs and sale to public major difference in prices, this is misused.

Interviewee 6: If the department make policy to prioritize converting the entire system. If it is Policies it should be implemented.

Interviewee 7: Savings on resources – electricity is limited. Assist beneficiaries who cannot afford services.

Interviewee 8: Should look at benefits. It is going to benefit the environment and eco- system if it is not done earlier future generations will bear brunt of it.

3.1 When researching green construction practices on SHSD, what sources of information do you use?

Interviewee 1: Internet, speaking with other consultants, magazines, practical visits of projects done. CC & SC – Practical visits of project done.

Interviewee 2: Internet, speaking to other consultants, magazines (advertising). Suppliers and sub-contractors (rated one as only in it for financial gain). 'Greenwashing' – Green Council just in it to make money. Internet. SANS Guide. 150 Suppliers on a weekly basis – evaluate.

Interviewee 3: Internet, CSIR, Department of Human Settlements and the Green Building Council of South Africa.

Interviewee 4: Although the government guidelines (Red Book, DEAT guidelines, municipal

guidelines) were used, the collaborative input of the team of professionals (all appointed at the onset of the project – all bound to the end) was the most useful source of information.

Interviewee 5: Not applicable. No current experience. Rely on practical oriented knowledge.

Interviewee 6: We must use proven technology. China and Canada (demolished greenhouse gas factories) leading in green technology. Other countries that are doing on larger scale. Department of Minerals and Energy should visit other countries and get experts to come and teach us about these technologies.

Interviewee 7: All projects only specify 100 litre solar – Suppliers – best for best price. Department of Agriculture – farm housing – solar and batteries were considered (Ellies packages) – worked out too expensive for the client.

Interviewee 8: I don't have information about it. How I get information, the easiest way is to Google it (use internet) and then you take it from there.

3.2 How useful do you think these sources are?

Interviewee 1: Seeing applications of what has been done in practice is the best.

Interviewee 2: Most people push their own products and sources are therefore not useful. Not very useful. Specifiers – No method of really measuring quality. Agreement Certificates – All get approved – Flood the market.

Interviewee 3: Extremely useful.

Interviewee 4: Literature not so useful – principles set are not in dispute. The practical, affordable, acceptable implementation was sometimes a challenge. Professionals and officials – better source.

Interviewee 5: Internet is fantastic. Information is freely available. Lots of fakes, but go through and do research about geysers and solar power you will get a good idea and you dont have to go and buy books anymore.

Interviewee 6: Useful because it's been proven beyond a reasonable doubt.

Interviewee 7: Not applicable.

Interviewee 8: It depends on which sources you look at. Reputable sources such as universities, etc. are reliable and accurate.

3.3 Do you find or experience limitations within the information sources currently available?

Interviewee 1: Not applicable.

Interviewee 2: Mostly selling – do not have knowledge. Product knowledge – not knowledge on implementation. Example – Solar – Storage/battery detail missing. Detailed technical knowledge missing or lacking. Labour implications – mechanized – Go hand in hand with community upliftment.

Interviewee 3: No. However, limited information about local practices compared to international sources. But this has improved rapidly over the past six years.

Interviewee 4: Refer to previous answer.

Interviewee 5: Not really. There is a variety of fields you just need to spend time. To speak to locals is difficult for them it is more about marketing than anything else. Greening is over-marketed and honesty and integrity is lacking.

Interviewee 6: Limitation is the fact that there are no information, but rather the availability and visibility of the information. Must become public knowledge, effort must be made to accomplish this.

Interviewee 7: Not too well known in South Africa, especially in the Free State. Suppliers also don't have experience.

Interviewee 8: Haven't fully tapped into it. Not applicable.

3.4 What do you currently consider as best practices regarding green construction in HSD?

Interviewee 1: End-users are not interested in social housing and other green strategies. Personal opinion, lack of education. End-users require a changed mind-set. Viewpoint must change to gaining an asset. Solar (easiest) and insulation – makes a major impact.

Interviewee 2: Integrated housing. Pressure on everyone to make it work. Municipalities

have different levels of approval, therefore dependant on municipal officials. Sustainability – revolves around economies – not greening. Create sustainable environment.

Interviewee 3: Rain water harvesting. Correct orientation of housing units on site. Roof insulation and significant roof overhangs. Responsible use of unrenewable, virgin resources during construction on site. Maximizing passive solar heating and cooling.

Interviewee 4: Not applicable.

Interviewee 5: It is difficult. Solar geysers and solar power we have a lot sun, there are room to implement it. One should aim for 50% 'Eskom' and 50% self. Roofs on current project well suited for it, so there are room for it. But initial capital outlay should be considered.

Interviewee 6: I would say besides technical. Getting stakeholder management. Government influence the solar industry and bulk purchases reduced prices. It is now implemented on a national scale. Government to get help from other countries. – R29 billion that was invested on new power stations – should have rather gone to greening – source materials directly from China.

Interviewee 7: There is a gap in industry. Government looking at speed rather than green.

Interviewee 8: Human Settlements. Currently not practice green housing. For them to practise green housing they need people with insight to go to them and give them research regarding greening and enlighten them on pros and cons of green housing.

4.1 What, in your opinion were the costs implications of green construction on the SHSD?

Interviewee 1: Cosmo City: Was not specifically planes and decisions made not to implement.

Interviewee 2: Cosmo City: Not much. Savanna City: Only direct costs – Mostly covered by additional subsidy quantum. From design already knew where they were going. Not really indirect costs. Green hype – taken everyone by storm. As it is today greening is more expensive. Capital Investment VS Savings. Professional Fees – some load fees by stating additional services.

Interviewee 3: It depends on the greening measures implemented. Mostly, material cost

increases (better quality = more experience) or additional of materials (such as insulation, bigger roof overhangs).

Interviewee 4: Many of the initiatives planned were not implemented due to a lack of funding and a lack of responsibility regarding implementation and maintenance. Costs which were accepted as part of the greater project were (amongst other) designed xxx xxx green areas, wider reserves for pedestrian movement, xxx of large areas of open space and for communal use. Also time delay in coming to green on how greening should be accommodated.

Interviewee 5: It will have a great implications on geysers alone have a big impact + - R5000.00. It is a lot if you take into consideration you working on 100 units. The initial cost are high, but on the long term it would help. If you put-up solar panels and build a room to save-up the energy generated you could save. We have no excuses for not doing it. There can be a lot of power being saved. It is easy to give advice from the other side of the fence. Could give much help if managed well by government.

Interviewee 6: It does affect cost. There is a Subsidy quantum that the Department budget for, it is currently R131000, If the R131000 is to build a house they need to sought funding elsewhere to fund 'solar'. It is not budgeted for. Grant are not enough for solar.

Interviewee 7: It will certainly cost more. I have limited knowledge but because it is more specialized areas. Solar more expensive to implement like example the geysers so the initial costs be higher. One of big reasons is that it costs more. The people are having set quantum on which there are an extreme backlog on housing. The government can build more houses in the budget if they do not go green.

Interviewee 8: Will reduce costs of house. It will reduce labour cost. This is where it comes in the Department are sceptical. Many have come with green concepts. But Human Settlement represent job creation and once you start with greening it reduces labour it causes trouble for the locals and that's why they start protests. The Department should inform the communities of greening.

4.2 Did all stakeholders on SHSD projects have consensus regarding the cost implications of 'going green'? Please motivate.

Interviewee 1: Cosmo City: Yes. Rebate – Solar panels installed after funding was secured. Has one point electrical connections. Savanna City: Yes. Increased subsidy allowed for

changes, including internal electrical reticulation.

Interviewee 2: Cosmo City: Yes. Savanna City: House designs changed from Cosmo City – Increased perception of value (high line windows for example). All have consensus. Province upped the subsidy, therefore even they agree.

Interviewee 3: Not Applicable.

Interviewee 4: No – for instance SUDS were planned, including area on planned open spaces. The parts department refused to carry the maintenance burden of these structured/**poners** as well as the safety risk and Johannesburg Roads Agency also did not want to maintain the parks areas (against their policy) – end result **pip**ed/designed **stanwork** structures)

Interviewee 5: Haven't had many conversations. It is usually discussed prior to contractor involvement.

Interviewee 6: They are in agreement. We take a knock, but we sacrifice good to get better. Should have a budget for it now. Criteria used to identify who gets geysers – family has warm water and this dignifies them.

Interviewee 7: I did not really have had to talk about it. I've never been involved in that.

Interviewee 8: Not all will think the same, some will differ.

4.3 In your opinion, do various stakeholders shy away from greening due to a perception of increased cost?

Interviewee 1: In the current subsidized housing market you cannot shy away as it is part of the minimum specification, therefore you will either have the job or not. Developments are still linked to municipal approval. Integrated housing developments you have to implement – You will either have the job or not.

Interviewee 2: In human settlement development they cannot shy away as it is legislated. In private practice – definitely as it is not financially beneficial. Developments are still lined to municipal approval. Selling land (commercial entities in Savanna City) will do absolute minimum. Don't know if buy-in would be affected. No, all have to make it work. Part of development cost.

Interviewee 3: No. It is becoming 'expected' to incorporate some measures – largely due to changes made in national building regulations (SANS10400).

Interviewee 4: Cost relate to funding budget for implementation – which uses, in some instances, a problem which could be overcome. Problem was responsibility, sustainability and practicality.

Interviewee 5: Yes.

Interviewee 6: Yes, they do. If you go 30%, why not 100% (referring to solar geysers). The work speaks for itself.

Interviewee 7: Yes, certainly. You tend to stick with what you know. Which you learned over the years.

Interviewee 8: Definitely not cost more. Shy away because it reduces labour costs in construction and once it reduces the labour costs, it causes a problem in the community.

4.4 Were all stakeholders involved in SHSD projects well informed of the costs involved when 'going green'?

Interviewee 1: Cosmo City: Collective decision between developer and City of Johannesburg no to implement. Green initiative not well defined. Savanna City: Yes. All well informed. Notes: Looked at alternative green methodologies, but cost perceptions limited (end-user education). Social housing for example are not sought after and some beneficiaries literally run away when they see they have received social housing instead of a stand-alone unit. Housing subsidy not going away, new generation now applying, problem snowballing. Entitlement issues – generational nobody works, lack of education, don't pay for services – burden on municipalities. Maybe start paying for services after 8 year period has lapsed. However subsidized housing used as a political platform to win votes

Interviewee 2: Client developer – must make it work. It's not really a choice anymore – Legislation. QS to be creative in catering – economically. Cosmo City: Yes, all well informed. Not all green – 98% sold, commercial 2% - apply for exempt from greening. Savanna City: Green. Yes, all well informed, all professionals have to be as it is part of their job. Notes: All parties to be included from the beginning of a project. Take subsidy – plan 40m2 unit – take budget back to Province – to increase. Province cover 70% of bulk infrastructure. 10 Year –

National earmark as Mega Project. 5 Year (Subsidized – Yes, FLISP Bonded – No).

Interviewee 3: Yes.

Interviewee 4: No.

Interviewee 5: State project – difference in knowledge. You see 'green' and government sees 'red'. Need for social housing is unending. There are various examples in Windhoek and Bangkok which are state subsidized, but it's about the heart. Note: Get people who ask about social housing, but should be well managed. Housing opportunities should be given to all.

Interviewee 6: I think most stakeholders are not clued up. Solar geyser costs around R7000, but we don't know what informed that price. For example fuel there is a declared national price and the further from depots the more expensive it becomes. But with solar we don't know.

Interviewee 7: General knowledge is poor. Have to come from the client before implementation. People are not informed.

Interviewee 8: No. If knowledge was good it would have been implemented. Note: SANS10400 – previous projects not implemented. May be lack of knowledge of consultants or ignorance.