Sustainable Construction in the Real Estate Value Chain through Land Conversion Planning and Development Activities: A Study in the Greater Durban Area

by

Dean Young

YNGDEA001

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Abstract

Construction activities have a significant impact on the community, the economy and the environment and thus a holistic and sustainable approach is required to address the negative impacts. Sustainability is assessed in terms of the triple bottom line, environmental, social, and economic elements. It is argued that the master developer and government agencies set the scene for sustainable construction in the real estate value chain. This research aims to establish the barriers to sustainable construction and the strategies necessary to overcome the barriers to sustainable construction in the real estate value chain from an agricultural land conversion to urban use perspective. A mixed method study was undertaken to examine the knowledge and understanding of agricultural land conversion real estate developers and professionals, as well as end-users, in adopting sustainable construction in real estate development within the context of Durban, South Africa real estate business environment and examines the gap and barriers between knowledge and implementation. A mixed methodology was applied in this study, comprising of 27 questionnaires and 9 interviews with experts in the field of land conversion activities. The sample size was limited, due to the limited number of firms involved in land conversion activities in Durban and was further limited by the number of senior decision makers that responded to the surveys and interviews. The findings highlighted that, due to the limited awareness and training, limited incentives and subsidies and the perceived higher cost of sustainable construction, strategies should be employed to improve the implementation of sustainable construction throughout the real estate value chain at a precinct level.

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My light and guide, I am thankful to God Almighty for who makes all things possible.

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List of abbreviations

BREEAM	Building Research Establishment Environmental Assessment Method	MFMA	Municipal Finance Management Act
CBD	Central Business District	NBI	National Business Initiative
CBE	Council for Built Environment	NDP	National Development Plan
CS	Corporate Sustainability	O&M	Operations and Maintenance
CSIR	Council for Scientific and Industrial Research	PPP	Public Private Partnership
CSR	Corporate Social Responsibility	ROI	Return on Investment
DBSA	Development Bank of South Africa	SAICE	South African Institute of Civil Engineering
ECSA	Engineering Council of South Africa	SC	Sustainable Construction
EDGE	Excellence in Design for Greater Efficiencies	SD	Sustainable Development
FIDIC	International Federation of Consulting Engineers	SuDS	Sustainable Drainage Systems
GBCSA	Green Building Council of South Africa	SOE	State Owned Enterprise
GBM	Green Building Material	SP	Sustainable Procurement
GBP	Green Business Park	SPLUMA	Spatial Planning and Land Use Management Act, 2013
GFC	Global Financial Crisis	SRL	Systematic Literature Review
GHG	Green House Gases	SUT	Sustainable Urban Transformation
ISO	International Standards Organisation	WBCSD	World Business Council for Sustainable Development
LCC	Life Cycle Costs	WCED	World Commission on Environment and Development
LEED	Leadership in Energy and Environmental Design	FM	Facilities Management

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CHAPTER ONE: INTRODUCTION

1. Background to Research

1.1 Introduction

Sustainable construction is faced with numerous challenges, externalities and issues. Various authors have written about the externalities of construction and development. These challenges are largely environmental and include disturbance and damage to air, water as well as consumption and depletion of natural resources. There are various forms of disturbance and damage to air quality during construction, including air pollution, dust pollution and particulate matter generation (Abidin, 2010; Akadiri, Chinyio, & Olomolaiye, 2012; Pitt, Tucker, Riley, & Longden, 2009; Yao, Shen, Tan, & Hao, 2011). Other challenges identified include energy consumption and waste generation (Darko, Chan, Ameyaw, He, & Olanipekun, 2017; Gou, Nik, Scartezzini, Zhao, & Li, 2017; Holtermans & Kok, 2017; Pitt et al., 2009; LY Shen, Song, Hao, & Tam, 2008).

In addition, environmental issues that are impacted by construction include water pollution and consumption, destruction of vegetation and dust pollution, soil erosion, productive soil loss and disturbance, ecological upset in ecosystems and migration paths, habitat loss and damage (Abidin, 2010; Boyle, Michell, & Viruly, 2018; Ortiz, Castells, & Sonnemann, 2009; Piquer-Rodriguez et al., 2018; Pitt et al., 2009; Liyin Shen, Zhang, & Zhang, 2017; Williams & Dair, 2007; Yao et al., 2011).

On the other hand, the benefits of construction are largely social and economic and include employment, profit prospects, social security, health, social benefit (Ellison, Sayce, & Smith, 2007; Hwang, Zhu, & Tan, 2017; Martens & Carvalho, 2017) but also attract social challenges such as crime during the construction phase and subsequently, electromagnetic field generation, light and noise pollution (Azhar, Carlton, Olsen, & Ahmad, 2011; Hussin, Rahman, & Memon, 2013; International Standards Organisation (ISO), 2016; Olubunmi, Xia, & Skitmore, 2016; Pitt et al., 2009; Williams & Dair, 2007; Yao et al., 2011)

Martens and Carvalho (2017) argues that it is not possible to consider the mutual societal benefit and environmental protection without simultaneously considering economic development. It seems logical that the economic aspects of construction will naturally be taken care of by the real estate participants, whilst the environmental aspects and protection requires special consideration. The economy, environment and the community are significantly impacted by construction activities (Shi, Zuo, Huang, Huang, & Pullen, 2013).

> "Sustainable construction (SC), outlines the creation and management of a healthy built environment based on resource efficient and ecological principles and aims to strike a trade-off between the economic, social and environmental (triple-bottom Line (TBL)) dimensions of sustainability"(Gan, Zuo, Ye, Skitmore, & Xiong, 2015, pp. 61-62).

Sustainable construction is the consideration of construction activities throughout the project life cycle and requires all stakeholders in the value chain to adopt sustainability practices (Gan et al., 2015).

"Sustainable construction is seen as a way for the construction industry to contribute to the effort to achieve sustainable development" (Abidin, 2010, p. 422). Many writers have attempted to define sustainable construction, the best found has been stated by Zainul Abidin and Pasquire (2005) as the application of principles of sustainability within the construction industry. This includes:

> *"[s]howing concern for people by ensuring they live in a healthy, safe and productive built environment and in harmony with nature; [s]afeguarding the interests of future generations while at the same time, meeting today's needs; [e]valuating the benefits and costs of the project to society and environment; [m]inimising damage to the environment and its resources; [i]mproving the quality of buildings and services and promote social cohesiveness; [u]sing technology and expert knowledge to seek information and in improving project efficiency and effectiveness; [l]egislating compliance and responsibility." (Abidin, 2010, p. 422)*

According to Abidin (2010) sustainable construction is a concept, not a definition, and is the union of three anchors: environmental protection, social progress as well as economic prosperity.

To understand sustainable construction Dwaikat and Ali (2018) argue that it is necessary to embrace sustainability. Abidin (2010) further argues that sustainable construction consists of several interlinked elements, namely: 1) "protection of the environment"; 2) "prudent use of natural resources"; 3) "social progress for everyone"; 4) "maintaining economic growth"; 5) "quality of life and customer satisfaction"; 6) "environmental planning, [and] management" and 7) "control and generating profit without compromising future needs"(Abidin, 2010, p. 424). Martens and Carvalho (2017) submits that social considerations about the end users, the community safety and health and education of people involved in the project are key aspects that are often dismissed when considering sustainable construction. Over the long-term, integration of all of these considerations would improve the performance of the project including the quality of life of people affected by projects. Sustainable construction is seen as social progress for everyone, as it considers human feelings as well (for example, security, satisfaction, safety and comfort and human contributions, skills, health, knowledge and motivation). In addition, sustainable construction has to do with the construction of more open

spaces that promote interaction between neighbours and encourage social cohesion. Furthermore, with proper planning, environmentally-friendly projects would be more marketable and profitable. Darko et al. (2017, p. 323) argue that sustainable construction should focus on the impacts of the built environment on "human health, resource depletion, and environmental degradation".

Environmental protection refers to activities within construction which may have an impact on the environment.

> "Conserving the natural elements such as trees and waterways, creating more green areas by improving [the] landscapes, selecting green materials that are biodegradable and [nontoxic] for the [project], minimising energy use or going for renewable energy sources, controlling the pollution that [results] from the [projects] activities; improving land protection during clearing [activities] to reduce problems [with] landslides, deforestation and soil erosion"(Abidin, 2010, p. 424).

Abidin (2010, p. 424) contends that "the decision to be environmentally friendly will have a positive impact on society" citing examples where soil erosion protection and careful land clearing measures also protect humans and buildings from the risk of landslides. Olubunmi et al. (2016) argues that sustainable construction is simply "doing the right thing".

Sustainable construction also has to do with "good green design and orientation, a project can maximise the natural lighting, wind and vegetation for natural cooling and landscaping" thereby lowering operating costs and thus increasing economic value. Sustainable construction means improving "accessibility for people and create open spaces for people to enjoy. Both will add value to the project and attract buyers thus ensuring income for the developers" (Abidin, 2010, p. 424). Abidin (2010, p. 422) finds that sustainable construction is typically regarded as being associated with environmental aspects, less so than social wellbeing and least with economic benefits. This finding concludes that sustainable construction has least "to do with the monetary gains from the project for the benefit of the client, construction players, public and the government".

"Realising sustainable places is part of sustainable urban transformation (SUT)... [including] sustainable urban structures and environments and (radical) economic, social, cultural, organisational, governmental and physical change processes" (Ernst, de Graaf-Van Dinther, Peek, & Loorbach, 2016, p. 2988). To achieve this, it requires construction with sustainability in mind throughout the real estate value chain, from the design phase through to the stabilisation and ultimately demolition, recycling or renovation phase. Sustainable construction will be analysed as it relates to activities in the agricultural land conversion process to urban use, rather than building and user related resource usage and demolition, recycling and renovation, however it is acknowledged that the former is difficult to analyse without the latter being considered in the design, planning and

implementation of construction works and activities – sustainable development, sustainable construction, sustainable infrastructure and green buildings are inextricably linked – since sustainable construction is concerned with life cycle cost analysis rather than point in time analysis. “Despite growing data that sustainable companies have outperformed standard companies by 15% between 1994 – 2000” (Tan, Shen, & Yao, 2011, p. 225), yet there is little evidence of real estate companies driving sustainable construction and “there are few examples of actual sustainable urban developments” (Ernst et al., 2016, p. 2988).

Our modern world has seen the assessment of economic performance above environmental and social performance (Gan et al., 2015), pointing to the need to elevate the latter through measures and strategies to assist with promoting sustainable performance in all its forms. Developers focus is on economic performance and sustainability in the current project feasibility practice, whereas “[g]overnments emphasis is on development for the eradication of poverty and the provision of basic housing instead of environmental issues” (Gan et al., 2015, p. 61). Furthermore, owners on the other hand regard sustainable construction as “nice-to-have”.

Abidin (2010, p. 425) opine that when “Developers interests in sustainability improve, the rest of construction players such as contractors and consultants will be pulled towards this direction”.

Gan et. al. (2015, p.62) argue that “owners are the demanders in the building sector, their willingness and their needs shape the products and processes”, [the] owners subsequent decision-making and practices are more likely to promote sustainable construction.

(Abidin, 2010, p. 424) argues that “developers who have strong capital, good [reputations], wide range experience and expertise, those targeting high income earners and foreign investors as potential buyers are interested in [“green”] concepts as it is seen as better quality in design. One developer stated that only 10% of developers are really interested in [environmentally]-friendly projects. It will take some time before it will become a nationwide interest”. Having sustainability and climate change mitigation strategies included in the masterplan from the onset makes it easier to propose green design, green infrastructure, green materials, green buildings, and green systems.

> “Urban planning and the construction industry intertwined under the context of urbanization. The construction industry has a significant impact on the environment and society, and is a major sector involved in achieving sustainability” (Gan et al., 2015, p. 61).

Therefore, the construction industry has a critical role to play in sustainable urban development (Wang, 2014).

A better understanding of sustainable construction in the pursuit of the creation of sustainable urban places is needed. The research results provide important reference points to assist developers, owners, consultants and government departments to take actions towards mitigating sustainable construction barriers in the real estate value chain (Liyin Shen, Zhang, & Long, 2017). Abidin (2010, p. 425) opine that "to ensure sustainable practices are blended into the project decision making [sustainability] must be made explicit as early as possible and become part of the master planning".

Gan et al. (2015, p.62) argues that "every stakeholder makes specific contributions to improving sustainability, [but] owners play a critical role in requiring other stakeholders to adopt sustainable construction practices". Abidin (2010) submit that the key is government who provides the laws and regulation, policy support, incentive schemes and enforce the implementation. However, Olibunmi (2016) argues that internal incentives are better than government incentives as these appeal to owner's goodwill (the "carrot") bringing long-term change rather than penalise (the "stick") which is often short-term and if removed result in regressive behaviour. Incentives are a discussion point for further research.

Interventions and incentives have a role to play in requiring every stakeholder to adopt SC practices to promote efficient resource utilisation (energy, air, light, water, soil, materials, recycling and waste generation and management) and ecological principles with the aim of striking a balance between the sustainability dimensions of: economic, social and environmental factors. Gan et al. (2015, p.62) state that,

> "[F]or example, in Malaysia, although governments have initiated the implementation of SC, owners are not willing to shift from the conventional approach or venture into new realms of technology."

Developers and project owners play a critical role as they are involved in both procurement and sales processes and can play an influential role in green procurement, green sales and green leasing through requiring this in contractual agreements. Project financiers and fund managers can likewise mandate that these criteria are included in the procurement and sales process. Consultants will generally have a role to play in green procurement and sales to the extent required by laws and regulations and usually only to the extent that can be justified as "carrot" incentives rather than stick enforcement.

The range of economic external financial and non-financial incentives, internal incentives, strategies and regulations, standards and codes (e.g. ISO 16 745 - environmental and ISO 26 000 - social) used by the government in a South African context to systematically promote sustainable construction (e.g. environmental policies and regulations), law and regulations (e.g. National Water Act No 36 of 1998,

National Environmental Management: Air Quality Act, 2004, Waste Act, 2008) technical standards, SABS standards, green building standards and rating (e.g. GBCSA Green Star rating, LEED, BREEAM, Envisionv3^{TM}) have been studied but not specifically written about in detail in this research paper.

It is interesting to note that research to date in the area of sustainable construction has focused on building construction with minimal attention to the conversion of land from agricultural land use to urban use.

1.2 The Research Problem to Address

Construction activities have significant impacts on the economy, community and the environment. Few organisations in South Africa adopt sustainable construction practices in the real estate value chain. Rarely do role players bring integrated sustainable construction into the decision making and business practices. For many developers and professionals, environmental and social aspects are not a priority. Little is written in the literature about sustainable construction in the agricultural land conversion process of the real estate value chain context.

Addressing this issue can provide legislators, policy makers, urban planners, entrepreneurs and industry captains with references for urban sustainability. The research results provide important reference points to assist developers, owners, consultants and government departments to take actions towards mitigating sustainable construction barriers in the real estate value chain and thus promote a more sustainable development future.

1.3 Research Question

What are the barriers and constraints to sustainable construction, in the land conversion process of the real estate value chain?

1.4 Research Aim

The aim of this research is to establish the foundation necessary for sustainable construction in the real estate value chain. To this end, it will examine the knowledge and understanding of agricultural land conversion real estate developers and professionals, as well as end-users, in adopting sustainable construction in real estate development within the context of South Africa real estate business environment and examines the gap and barriers between knowledge and implementation.

This dissertation focuses on analysing and characterising sustainable construction (SC) in the real estate value chain, exploring the benefits and barriers of sustainable construction and seeks to establish the key elements influencing sustainable construction and development, and the corresponding barriers. The terms “green building”, “sustainable construction”, “sustainable development”, “green development”, and “green procurement” are used extensively to illustrate the

interlinked nature of these components. An attempt is made in the literature review section of this dissertation to differentiate each of these terms, however, as will be explained, the dominant theme relates to looking after what we have today so that future generations are not negatively impacted by today's economic decisions. The drivers and incentives of sustainable construction are explored, although not explicitly dealt with, before pointing to the need to develop strategies to overcome the barriers.

The research aims to illustrate, with more real estate actors and practitioners joining hands to shift from traditional construction practices to sustainable construction practices, the industry will eventually journey towards a brighter future together.

1.5 Research Proposition

The research proposition for this paper is as follows:

The barriers and constraints of sustainable construction, in the land conversion process of the real estate value chain can be identified.

1.6 Research Objectives

To answer the research question posed, the research objectives are:

- Understand the literature pertaining to the real estate value chain (differentiating between land conversion, building construction and ongoing operations thereafter), sustainable construction, sustainable buildings and the barriers to sustainable construction.
- Understand the term sustainable construction and what level of knowledge and understanding do developers and participants have concerning the concept of sustainability, sustainable development and sustainable construction?
- Identify and analyse the barriers and constraints to sustainable construction and how it effects the land conversion process of the real estate value chain.

1.7 Research Method

In answering the research question and achieving the research objectives, the following research methodology was employed:

- A systematic literature review (SRL) was performed to gain an understanding of the key aspects of sustainability in the context of agricultural land conversion activities followed by survey-based research based on land conversion development projects within the Durban metropolitan area, north and west of the central business district (CBD). The literature review

is essential to study the link between sustainable construction theory and the real estate value chain literature.

- A mixed method methodology was adopted, comprising a mixed method form of data collection techniques:
    - Quantitative – a survey of professionals involved in the planning, design and execution of land conversion development was performed.
    - Qualitative – semi structured interviews with selected professionals was carried out.
- The data analysis comprised the following:
    - The quantitative data was analysed using descriptive statistics from the surveys performed; and
    - the qualitative data from the interviews was analysed using thematic analysis and interpretation.
- Lastly, conclusions are drawn, and recommendations made.

1.8 Limitations

The study was limited to land conversion activities in the greater Durban area, with some meaningful perspectives from experts from across South Africa.

1.9 Structure of Research Report

Chapter one introduces the study detailing the problem statement, research aim, research question, the research proposition, the research objectives and an outline of the research method.

Chapter two provides a critique of the real estate value chain, sustainability, sustainable development, sustainable construction, green buildings, green construction and green procurement literature. This includes an identification of problems with the literature that has been written previously.

Chapter three details the research methodology employed, including why the mixed method approach was adopted.

Chapter four provides discussion of the evidence of the data, the data analysis, the results and findings. In this chapter the qualitative and quantitative findings are presented and explained before, later summarised in the conclusion chapter.

Chapter five will provide the conclusions and recommendations reached from the research conducted and provide an indication of the possible areas for further research.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

The purpose of this chapter is to provide a systematic literature review of the real estate value chain, understanding the major players in the real estate value chain and studying sustainable construction by analysing the various components of sustainability. These components include economic sustainability, environmental sustainability and social sustainability (collectively referred to as the triple-bottom-line dimensions). Sustainable development was studied as another dimension of sustainability, since sustainable construction needs to be understood within the broader concept of sustainable development. Sustainable construction is defined, and the necessary analysis undertaken to understand the interlink of sustainable buildings, green procurement, life cycle analysis, costing and corporate responsibility since, to a large extent, sustainable construction and development can only be brought into the mainstream when this becomes a mainstream theme in corporate strategies and objectives.

Finally, the major barriers to sustainable construction are identified.

The literature review was performed by creating a template in MS Word, performing the literature review using NVivo and EndNote to store primary source material such as journals, papers, manuscripts, surveys, interviews, audio recording etc. as well as external material and memos such as insights, observations and interpretations. The results of the literature review were transcribed into MS Word and referenced using EndNote.

The literature was then supplemented by reference to the integrated annual reports and websites of various land conversion developers and the management associations to obtain a list of professional firms involved in land conversion activities.

2.2 Real Estate Value Chain

The real estate value chain comprises land conversion activities, construction and operation of building and infrastructure to support the urban environment. Land conversion can be defined as the process of transferring agricultural land from “one type of use and user to another”, the process where land is transformed from agricultural use to urban uses or the activities of transforming “arable land into non-arable uses” especially in residential, industrial, and infrastructural networks (Azadi, Ho, & Hasfiati, 2011; Mohsin & Khan, 2017; Phuc, Van Westen, & Zoomers, 2014, p. 1). The Spatial Planning and Land Use Act 2013 defines land development to mean:

> "the erection of buildings or structures on land, or the change of use of land, including township establishment, the subdivision or consolidation of land or any deviation from the land use or uses permitted in terms of an applicable land use scheme."

Pagliari (1995) describes the five stages in the agricultural land conversion cycle as: 1) raw land/ unimproved; 2) pre-development land; 3) development; 4) improved land; 5) redevelopment (Pagliari, 1995, p. 278). These stages will be explained further.

Raw land is "real property without any physical improvements (such as sewers, roads, utilities etc.) and without the required zoning approvals and / or entitlements for the intended use… [i.e.] land that is not actively or passively being developed" (Pagliari, 1995, p. 278). It includes land categories such as agricultural and commodity land, "land on the edge of development". "Agricultural land is considered as 'available for change', whilst forests, wetlands, or barren lands are considered 'unsuitable for development' from the perspective of environmental conservation" (Huang, Zhang, & Wu, 2009, p. 382).

The interim use for this type of land is a variation of agriculture, timber, sugarcane, open grazing spaces whilst land is being considered for highest and best use. It is often referred to as undeveloped land, although from an agricultural perspective this may be misleading, as certain land may have dams, irrigation and other infrastructure and hence be termed developed land in agricultural terms. Agricultural land is further defined in the Subdivision of Agricultural Land Act 70 of 1970.

Pre-development land is land that is fully entitled / permitted, but full infrastructure is not in place. Predevelopment land is land ready for engineering services (as defined in the Spatial Planning and Land Use Act 2013 as a system for the provision of water, sewage, electricity, municipal roads, stormwater drainage, gas and solid waste collection and removal required for the purpose of land development) infrastructure construction and physical land development, but such physical activities have not yet begun. Pre-development land is land released from agriculture, zoned out of agricultural use into urban use, but documentation and procurement for the physical service delivery construction has not begun. The investors intention is to purchase large bulk land parcels at a discounted price with the added benefit of enhancing returns to both the buyer and the seller.

The pre-development activities include: zoning, subdivision, design development for installation of utilities, negotiation of servitude agreements, off-site agreements for the storage of equipment during planning and construction, land planning, geotechnical grading and developing engineering plans (Pagliari, 1995, pp. 278-280). Pre-development land may have an interim use but is limited by income over the anticipated period measured against the cost of implementation of plans. Sustainable construction needs to be considered at this stage and planned for, to ensure the implementation of

sustainable construction during the development land stage. The land developer, including the professional team (urban designer, planning consultants, engineers, landscape consultants, traffic consultants, government, lawyers, regulators and the community) must build sustainable construction considerations into the pre-development stage of land development. Green procurement strategies, discussed later in this chapter, need to be consistently applied throughout the pre-development land stage, development land and improved land stages to ensure that the triple-bottom line (social, environmental and economic aspects) is considered at an early stage of the real estate value chain. It is at this stage also that disposal, redevelopment and waste management is considered to ensure that sustainable construction move beyond sustainability to designing for abundance as promoted by McDonough et al. (2013) in "The Upcycle" (McDonough, Braungart, & Clinton, 2013). At this stage consulting engineers, urban designers, town planners and developers should have incorporated sustainability into the design of the urban design of the land conversion process.

Development land, on the other hand, is land that is fully entitled with development rights, with full infrastructure in place (mostly sub-surface) on- and off-site, and all utilities present and serviceable. (Pagliari, 1995, p. 281) It is often referred to as "shovel-ready- vacant" land (Tongaat Hulett Limited, 2018) that is ready for the intended commercial or residential use before construction of the physical building and supporting structures commences. It is property ready for immediate construction and typically the investor's goal at this stage is to market the property to users of the site. Development land includes developable sites / plots, open spaces / undevelopable hectares, wetlands (Benayas, Martins, Nicolau, & Schulz, 2007), scenic sites etc. Land development (pre-development and developed land) requires extensive technical expertise, with development land requiring more intense "hands-on" input on a continuous basis than pre-development land but is closer to the user. Therefore, this stage is closer to the point where the investor sees greater returns than the first two. It is this land where the overlap between the building developer and land developer occurs. The building developer will typically negotiate the sale agreement with the land developer subject to certain suspensive sale clauses. This creates the opportunity for the land developer to ensure that sustainable construction practices are implemented throughout the real estate value chain by stipulating in the sale agreement the requirement for sustainable construction downstream. Green building requirements and green construction considerations must be considered, by the land developer and building developer, in this stage of the real estate value chain. In addition to the professionals already mentioned above, the land developer's chosen brokers, financiers, contractors, management associations and other sales agents should be onboarded to ensure the implementation and enforcement of sustainable construction practices.

Improved land, in contrast, is property with a building or structure erected or already existing and in place (Pagliari, 1995, p. 282). The physical structure can be seen with the naked eye. Improved land includes developed sites, infill sites, urban renewal sites, and parking lots once developed, it excludes wetlands, open spaces, and undeveloped land. It is during the improved land stage that green buildings and sustainable construction are tangibly demonstrated. It is at this point that the architects, engineers, contractors, procurement consultants, building tenants and owners are fully supportive and implementing green procurement to promote sustainable construction, green buildings and the subsequent maintenance thereof.

Redevelopment land, although not focused on in this research, will be referenced as a consideration for sustainable construction. Redevelopment land is the final stage in the land conversion cycle. Redevelopment land is the subject matter of three potential decisions at the end of the improvements cycle. The decision options are to raze the improvements, renovate (Rabianski, Clements III, & Tidwell, 2009) or redevelop. These options range from where the existing structure is demolished (del Río Merino, Izquierdo Gracia, & Weis Azevedo, 2010) and then held or demolished and a new structure built. Sustainable construction practices are again important in this stage mainly relating to demolition, waste management, recycling, reusing and repurposing materials.

The development life cycle of the agricultural land conversion cycle starts with the land assessment and alignment with the relevant stakeholders and continues to the point where the land is handed over to the user and the management association for continued use.

On the other hand, in the built environment or building construction phase, the real estate value chain resembles the following phases: Land option and assembly, permitting and development design, construction, lease-up and tenanting (finishing) / sales, stabilisation (Geltner, Miller, Clayton, & Eichholtz, 2014) and demolition / renovation. Sarkis et al. (2012, p.42) represent the real estate value chain in the built environment life cycle as presented in the figure below. Within this chain is the element of supplier, consultant, contractor, facilities management selection and setting of environmental, social and economic requirements (including tender assessment and the evaluation criteria).

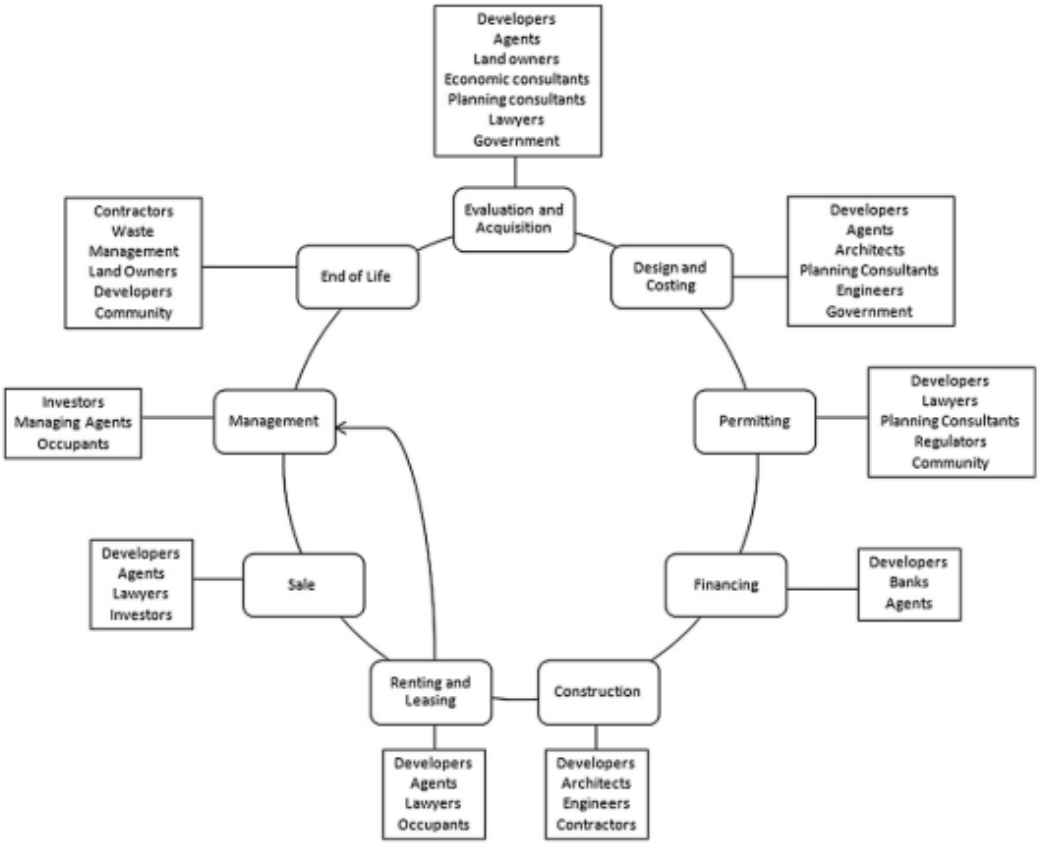

Fig. 1. The built environment life cycle for industrial/commercial buildings (adapted from RICS, 2004).

Figure 1: The built environment life cycle for commercial buildings

Source: (Sarkis, Meade, & Presley, 2012, p. 42)

The life cycle stages of the building that have been identified for sustainable construction evaluation are "pre-construction, building's design, construction, and operation and maintenance (O & M)" (Vyas & Jha, 2018, p. 108). The components addressed in these stages include: pre-construction (in this stage intra-site and inter-site issues are considered), building planning and construction (the consideration of a reduction in resource demand, efficient utilisation, conservation, recovery, reuse and recycling of resources as well as the consideration of tenants and occupant's health and well-being. The primary resources considered are land, water, green covering, energy, light and air (Vyas & Jha, 2018). Building O&M stage includes issues that affect the local area and the environment as well as building systems and processes for O&M, and measuring, monitoring and recording of consumption (Vyas & Jha, 2018, p. 108).

The building life cycle or value chain follows a similar value chain as the land development sector. The life cycle commences at the evaluation and acquisition (i.e. markets competitive analysis) stage, moving progressively to the design and costing (i.e. physical and design analysis), to permitting or entitlement (i.e. political and legal analysis) phase. Then to financing (i.e. financial analysis), to

construction, renting and leasing, to sales to investors or users through agents, developers' lawyers whilst concurrently establishing management agencies through body corporates, managing agents or building owners for the operations and maintenance of the building. The link with the land development sector is achieved through the home owners / management association until the end of the land development sector's participation, where the land developer sells substantially all land parcels in the development node and exits.

The focus of this research is on land that is converted out of agricultural use into urban use, (i.e. has been released from agricultural use and has the necessary entitlements and permits as well as the necessary infrastructure installed). Thus, development land / "shovel-ready-vacant" land (that does not have building improvements on the land) is the focus of this research.

2.3 Players in the real estate value chain

Phuc et al. (2014, p. 2)argues that affected households, developers and local authorities (including government agencies and state-owned enterprises (SOE)) are participants in the land conversion process. In addition, it is argued that "while the role of affected people tends to be passive and weak, state and government agencies are seen to play an active role in the process of decision-making and implementation of land conversion". Similarly,

> "developers are also active in the process and particularly resourceful in seeking strategies to successfully promote land conversion" (Phuc et al., 2014, p. 2).

Phuc et al. (2014) cites further stakeholders in the land conversion process as farmers or 'sitting tenants' and are an important stakeholder in the agricultural land conversion process as they are the ones that determine or allow their land to be sold and acquired for urban use, considering the timing and pricing of commodities produced. The agricultural land conversion process is thus seen as a tri-union of the developer, the farmer and the government agencies (or state-owned enterprises). Isaac et al. (2016), on the other hand, sketches the outline of the stakeholders involved in the development process. These stakeholders include the developer, the landowner, clients, buyers and end users, the community surrounding the development, the developers professional team and consultants, the local authority (including the interaction with provincial and national government in the development of the integrated development plan (IDP)), statutory bodies and government agencies as described in the Spatial Planning and Land Use Management Act 2013 Act 16 of 2013 (SPLUMA), development partners, funding institutions such as banks and development banks such as the Development Bank of South Africa (DBSA), the main contractor and the building owner. Manufacturers and other stakeholders are often neglected in many literature articles, despite playing an essential role in the real estate value chain. Phuc et al., (2014, p. 3) argue that developers also consist of domestic and

foreign investors as well as government, government agencies and state-owned enterprises, government and state-owned entities, however, seldom acquire land for private projects but rather are integral participant is large public projects and foreign investment projects.

These stakeholders, listed above, have a role to play in sustainable construction. Sustainable construction is defined later in the research under sustainable construction. Abidin (2010, p. 422-23) submits that construction practitioners need to comprehend sustainable construction sufficiently to be able to ensure that the decision and actions that they make both individually and collectively impacts the environment least as well as those actions and decisions that influence the actions of others. An amalgamation of effort from all developers is required to shift from traditional construction to the sustainable construction path of the future.

This means that the various professionals and players in the real estate value chain such as architects, building surveyors, electrical engineers, traffic engineers, quantity surveyors, civil engineers, mechanical engineers, energy and environmental engineers, project managers and directors, facilities managers, asset and building managers, sustainability consultants, urban planners, structural engineers, site engineers and managers, researchers, economist, contractors, lawyers, financial managers and developers (as well as many others) have a role to play to bring sustainable construction into the main stream. The players interact in the residential, commercial offices, retail, hotels, educational, hospitals, warehouses and light industry sectors of the real estate value chain.

Sustainable construction cannot be carried out without the full support of the landlord and a "sustainable approach in a rental property cannot be carried out without tenants occupying the properties" (Collins & Junghans, 2015, p. 134). Collins and Junghans (2015, p. 134) argue that the interdependency amongst construction stakeholders and the "complicated… cross-actor variable of cost benefit analysis associated with the sustainability strategy that is chosen" are common characteristics of sustainable construction and have an influence. Better co-ordination of all actors, developers, consultants, contractors, local authorities, manufacturers, purchasers, building tenants, owners have a role to ensure that project activities have minimal impact on the environment and positively impact a more holistic sustainable construction approach. This means that for sustainable construction to become mainstream all stakeholders need to be onboarded.

Abidin (2010, p.425) argues that:

> "[T]he government is singled out as the key party that can redress this situation through stronger enforcement of legislation, devising new policies, or giving incentives to developers who want to pursue sustainability in their projects. However, the burden does not rest on the government alone".

To analyse and characterise the sustainable construction practices in the real estate value chain it is necessary to understand the various components. In the forthcoming sections, the concept of sustainability, sustainable development, sustainable energy performance, sustainable / green buildings, sustainable construction practices, sustainable green procurement and corporate responsibility are studied as these concepts are interlinked. It is the nexus of these concepts that constitute sustainable construction.

2.4 Sustainability

Martens and Carvalho (2017, p. 1086) define sustainability as:

> "[A] process that creates a vision of community that respects the prudent use of the natural resources to ensure that the present generations achieve a high degree of economic security and can attain democracy and popular participation in the control of their communities while maintaining the integrity of the ecological systems and of life".

In support of this definition Martens and Carvalho (2017, p. 1086) argue that sustainability is a broad term that refers to a closed-loop system or supply chain that leverages the triple bottom line aspects of economic, social and environmental concepts in culture, corporate strategy and operations as well as environmental management.

McDonough and Braungart (2013) contend that sustainability should be looked at through the lenses of "cradle-to-cradle" and even more, beyond sustainability, by designing for abundance through the "upcycle". In their book it is argued that design should be used as a mechanism for positive and continuous improvement. The goal of upcycling has been introduced to promote a diverse, safe, healthy, and better world with clean air, water, soil, and power that can be enjoyed economically, equitably, and ecologically (McDonough et al., 2013, p. 13). Coining the concept of cradle to cradle (instead of cradle to grave) McDonough submits that the upcycle goes beyond sustainability to "designing for abundance". Martens and Carvalho (2017, p. 1085) further opine that sustainability is the ability to be self-sustaining.

At the intersect of economic sustainability, environmental sustainability and social sustainability lies sustainable development. Before discussing sustainable development, the components of sustainable development are discussed below.

2.5 Economic Sustainability

Economic sustainability is generally well understood and has been operationalized at the operational level, as the costs of producing or manufacturing (Cruz and Wakolbinger, 2008; Gimenez et al., 2012). Certain financial and economic performance indicators have been cited by, (Martens & Carvalho,

2017), for example return on investment (ROI), solvency, profitability, liquidity, value added, profit sharing, market share and gross domestic product. Isaac et al. (2016) refers to economic sustainability as measures and activities that tackle poverty and unemployment. Whilst the definition of economic sustainability is clear, the definition of environmental and social sustainability is sometimes not so clear.

GhaffarianHoseini et al. (2013) explains that economic sustainability can be understood in terms of financial return, project costs, land acquisition, and other factors of production including plant and equipment, materials, labour as well as energy consumption.

2.6 Environmental Sustainability

Martens and Carvalho (2017, p. 1086) argue that environmental sustainability refers to waste, pollution, emission, consumption of hazardous and toxic material reduction as well as energy efficiency at an operational level. Isaacs et al. (2016) refers to this as protecting the ecosystem which is often referred to as ecological living. GhaffarianHoseini et al. (2013, p. 13) prefers to equate environmental sustainability with preserving and protecting the natural environment with awareness of ecological footprints.

GhaffarianHoseini et al. (2013) describes environmental sustainability as ecosystem integrity, carrying capacity considerations and biodiversity. According to GhaffarianHoseini et al. (2013) the environmental impact can be divided into several sub criteria such as on-site operations, pollution and loss of habitat as well as operational life considerations including pollution and damages.

Galli et al. (2012, p. 101) submit that environmental sustainability has three environmental indicators to track the impact of human pressure on the earth's environment: 1) Ecological footprint; 2) Carbon footprint; 3) Water footprint. Broadly speaking the ecological footprint is a tool used to "track human demand on the biosphere's regenerative capacity". They argued further that, it is a "resource and emissions accounting tool" (e.g. CO_2 emissions, land-use change etc.). The ecological footprint is "expressed in units of area (i.e. global hectares) annually necessary to provide (or regenerate) the respective resource flow. The basics of this measure is that the ecosystem represents a surface area, where photosynthesis takes place, which is limited" (Galli et al., 2012, p. 102). The carbon footprint on the other hand":

> "measures the total amount of greenhouse gas (GHG) emissions that directly and indirectly caused by an activity or are accumulated over the life stages of a product… all direct (on-site, internal) and indirect emissions (off-site, extended, embodied, upstream and downstream) are considered. Carbon footprint and total amount of greenhouse gases is simply measured in mass unit (kg, t, etc.) and no conversion to an area unit takes place" (Galli et al., 2012, p. 102).

(Galli et al., 2012, p. 102) submit that water footprint, on the other hand, is a "consumption-based indicator of freshwater use and is closely linked to virtual water concept". It is measured in volume of freshwater demanded / used for human consumption. The key components tracked are 'blue water' consumption, the amount:

> "of surface and ground water [consumed]; the green water [consumption] refers to the consumption of rainwater stored in the soil as soil moisture. Grey water footprint refers to [the polluted water], is defined as the total volume of freshwater that is used to produce the goods and services consumed by the individual or community or produced by the business. Water footprint is measured through water volumes consumed (evaporated or incorporated into the product) and polluted per unit of time (e.g. l/day, l/month or l/year)" (Galli et al., 2012, p. 108).

Galli et al. (2012), proposes that these three measures of environmental footprint can be consolidated into one footprint family "to understand the diverse pressures human activities place on the planet" (Galli et al., 2012, p. 110) and is applicable to sustainable construction as a measure of the impact of construction activities on the environment. The International Organization for Standardization (ISO) has also developed ISO 14001 as a proxy for environmental standards.

2.7 Social Sustainability

Martens and Carvalho (2017) argue that to improve a company's social reputation, a company needs to be involved in corporate social responsibility (CSR) activities with attention on both internal communities (employees and parties) and external parties.

> Social sustainability means that organizations provide equal opportunities, encourage diversity, promote connectivity within and outside the community, ensure the quality of life, and provide democratic processes and responsible governance structures (Elkington, 1998).

Corporate responsibility is defined further under the same heading latter in this paper. Martens and Carvalho (2017, p. 1086) suggests that positive financial gains can be obtained when organisations behave in a socially and environmentally responsible manner. Isaacs et al. (2016) describes the concept of social responsibility as "combating inequality". Martens and Carvalho (2017, p. 1095) outline the main variables of social sustainability as, labour practices as related to "health, safety, working conditions, training and education, relations with employees, employment, diversity, opportunity, remuneration, benefits and career opportunities".

In addition to this, "relationships with local community impacts, child labour, human rights, non-discrimination, indigenous rights, forced and compulsory labour" (Martens & Carvalho, 2017, p. 1093) are highlighted. In fact, Martens and Carvalho (2017) further highlight "engagement of stakeholders", "financing" and "construction of social actions" (including corporate citizenship, leadership,

government “social projects and social influence” as key variables of social sustainability. The topic of social sustainability within the context of sustainable construction is indeed a broad topic as it also incorporates philanthropy, social competition and pricing policies, anti-bribery and anticorruption practices, relationship with suppliers (selection, evaluation and partnerships). In addition, social justice, society contribution to social campaigns and will be addressed more directly under corporate responsibility later in this research paper. An important and often underrated element of social sustainability relates to the product and service itself as it relates to the customer / user’s health and safety, marketing, respect and privacy. These considerations must be factored by the professional design team as these are elements that contribute to sustainable construction. The question may be asked as to how this relates to sustainable construction? These elements must be factored during the evaluation, design, costing, permitting and pre-construction activities, as they are considerations during the operation and maintenance phase and have a material impact on the development node.

Social responsibility, as opined by Martens and Carvelho (2017) also includes the freedom of association and collective bargaining through trade unions. This needs to be accounted for not only during construction but also as the development is put to use. Hence, space needs to created for this upfront in the urban design. Social sustainability is demonstrated through the existence of disciplinary procedures during the construction, pre-construction and operational phases. It is essential to have a human rights strategy and management plan comprising policies and procedures, even in the land conversion activities.

The ISO 26000 standard recognises two fundamental practices of social responsibility: 1) recognising social responsibility; 2) stakeholder identification and engagement. As this relates to sustainable construction the core subjects of social responsibility will be discussed in this paper linked to human rights, labour practices, the environment, fair operating practices, consumer issues, community involvement and development. ISO 26000 makes specific reference to the relationship between social responsibility and sustainable development and various other worthwhile principles such as accountability, transparency, ethical behaviour, respect for stakeholder’s interests, respect for the rule of law and respect for international norms of behaviour.

Social sustainability has many external benefits such as increased productivity, improved employment opportunities, better living environments, enhanced leisure activities and environments and better indoor environments, important element to be considered during the land conversion process and more so in the building occupation phase.

2.8 Sustainable development

The definition of sustainable development (SD) is broadly acknowledged to be “development that meets the needs of the [present] actual generations without compromising the needs of future ones or the ability of future generations to meet their own needs (WCED, World Commission on Environment and Development, 1987)” (Isaac, O'Leary, & Daley, 2016) and it is important in order to understand and to support the concept of sustainable construction. The report is named ‘Our Common Future’. The concept of sustainable development that is more acceptable is the one “based on the integration of economic, environmental, and social dimensions, designing the sustainability known as Triple-Bottom-Line (TBL)” (Martens & Carvalho, 2017, p. 1085).

The commonly referred to definition is as defined by the Brundtland Commission World Commission on Environment and Development (1987) report. Isaac et al. (2016, p. 2) opine that here are various definitions of sustainable development, but in essence, it is “development which supports a better quality of life now and in the future. The concept embraces economic, social and environmental dimensions”. According to Fu et al. (2015, p. 299) “[a] balanced mix of land uses leads to the co-location of socio-economic functions, and this yields liveable, sustainable and viable neighbourhoods”.

GaffarianHoseini et al. (2015) argue that the basis of sustainable development lies in the nexus of environmental sustainability, growth, development, productivity and trickle-down, social sustainability (cultural identity, empowerment, accessibility, stability and equity). It is at this joint meeting point that human wellbeing is found. GaffarianHoseini et al. (2015) describes the key factors of sustainable development, by development objective as: 1) financial return (project costs and project benefits); 2) energy consumption (operational energy and embodied energy); 3) external benefits and environmental impact. The objective of sustainable development is to maximise wealth, minimise resource utilisation, maximise utility and to minimise impacts on the environment.

Martens and Carvalho (2017, p. 1085) reflect that “[a]ccording to Araújo and Mendonça (2009), the concepts of SD and sustainability are distinct: SD is commonly associated with the expectation of a country entering in a growth phase and remain so over time, and sustainability is the ability to self-sustaining itself and self-remaining.” It is submitted that SD is associated with public policies whereas sustainability is related with private sector actions, which is also called corporate sustainability (CS) and includes all three pillars of sustainable development.

The United Nations has developed seventeen sustainable development goals representing the major challenges that universally confront our times, being: 1) “no poverty; 2) zero hunger; 3) good health and wellbeing; 4) quality education; 5) gender equality; 6) clean water and sanitation; 7) affordable clean energy; 8) decent work and economic growth; 9) industry, innovation and infrastructure; 10)

reduced inequalities; 11) sustainable cities and communities; 12) responsible consumption and production; 13) climate action; 14) better life below water; 15) life on land; 16) peace justice and strong institutions and 17) partnerships for the goals"(United Nations, 2020). The relevance of these goals has been mapped to the National Development Plan (NDP) by the National Business Initiative (NBI) namely, social protection, environmental sustainability and resilience, inclusive rural economy, health care for all, improving education, training and innovation, building safer communities, economy and employment, building capable and development state.

The sustainability breakdown structure of sustainable development is illustrated by Fernández-Sánchez and Rodríguez-López (2010, p. 1197 & 1199) as encompassing social sustainability (access to services, indoor conditions, air quality, safety, aesthetics and quality as well as culture, accessibility, participation, security, public utility and social integration), economic sustainability (cost, technical requirements, bureaucracy, social economy, heritage, adaptability, serviceability and maintainability) and environmental sustainability (soil, water, atmosphere, biodiversity, resources, energy and waste generation and change in land use).

A South African Perspective

Various legislative and regulatory frameworks have been developed in South Africa to foster sustainable development. For example, Section 24 of the Constitution states that

> "everyone has the right— (a) to an environment that is not harmful to their health or wellbeing; and (b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that— (i) prevent pollution and ecological degradation; (ii) promote conservation; and (iii) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development."

From a South African perspective, the Spatial Planning and Land Use Management Act 2013 Act 16 of 2013 (SPLUMA) make provision for general principles that applies:

> "to all organs of state and other authorities responsible for the implementation of legislation regulating the use and development of land and guide the preparation, adoption and implementation of any spatial development framework, policy or by-law concerning spatial planning and the development or use of land, the compilation, implementation and administration of any land use scheme or other regulatory mechanism for the management of the use of land; *the sustainable use and development of land*; the consideration by a competent authority of any application that impacts or may impact upon the use and development of land; and the performance of any function in terms of this Act or any other law regulating spatial planning and land use management"(Parliament of the Republic of South Africa, 2013).

Spatial Planning and Land Use Management Act 2013 Act 16 of 2013 provides that:

> "the principle of spatial sustainability, whereby spatial planning and land use management systems must i) promote land development that is within the fiscal, institutional and administrative means of the Republic; b) ensure that special considerations is given to the protection of prime and unique agricultural land, iii) uphold consistency of land use measures in accordance with environmental management instruments; iv) promote and stimulate the effective and equitable functioning of land markets; v) consider all current and future costs to all parties for the provision of infrastructure and social services in land development; vi) promote land development in locations that are sustainable and limit urban sprawl; and vii) result in communities that are viable"(Parliament of the Republic of South Africa, 2013).

In addition, Principle 2 of King IV™ on Corporate governance promotes sustainable development by requiring "members of the governing body should direct the organisation in such a way that it does not adversely affect the natural environment, society or future generations" (Institute of Directors Southern Africa, 2016, p. 44) Furthermore, Principle 3 of King IV™ Responsible Corporate Citizenship Recommended Practice 14 states "the governing body should oversee and monitor, on an ongoing basis, how the consequences of the organisations activities and outputs affect its status as a responsible corporate citizen."

SPLUMA further draws attention to the

> "principle of efficiency, whereby i) land development optimises the use of existing resources and infrastructure; ii) decision-making procedures are designed to minimise negative financial, social, economic or environmental impacts; and development application procedures are efficient and streamlined and timeframes are adhered to by all parties."

In addition, the Act requires that norms and standards are established that "promote social inclusion, special equity, desirable settlement patterns, rural revitalisation, urban regeneration and sustainable development".

Global Targets for Sustainable Development

GhaffarianHoseini et al. (2013) argues that the main targets of sustainable development for a low carbon future are resource efficiency, energy efficiency (including green-house gas emission reduction), pollution prevention (including indoor air quality and noise abatement) harmonisation with environment and integration and systematic approaches. In addition, when considering sustainable development in the context of these targets a further dimension of air, water, soil, energy, light, noise, waste generation, consumption of materials, electromagnetic emission, radiation, viral and bacterial pollution must be considered. The thermal performance of building materials are an essential consideration for sustainable development in the land conversion real estate value chain,

which when combined with building orientation and urban design has the potential to create zero energy buildings (ZEB) (GhaffarianHoseini et al., 2013).

2.9 Sustainable Buildings / Green Buildings

It is important to analyse sustainability in construction "from cradle-to-cradle" as promoted by (McDonough et al., 2013) from land conversion activities, building construction, to completion of the building, to operation and redevelopment or razing (repurposing) and if necessary back to agricultural land. (GhaffarianHoseini et al., 2013, p. 15) submit that a:

> "sustainable building is characterized by the following fundamentals: 1) demand for safe building, flexibility, market and economic value; 2) neutralization of environmental impacts by including its context and its regeneration; 3) human wellbeing, occupants' satisfaction and stakeholders' rights; 4) social equity, aesthetics improvements, and preservation of cultural values" .

The various components of sustainable development have been discussed with the aim of setting out the definition of sustainable construction below, that is the focus of this research.

2.10 Sustainable Construction (also termed Green Construction)

LY Shen et al. (2008, p. 59) submit that sustainable construction is a set of processes which offer client satisfaction and better quality of life and offers the opportunity to cater for future changes in use as well as the support for the creation of natural and social environments that are desirable. In addition, it facilitates the most efficient and maximum use of resources. Sustainable construction leads and contributes to sustainable development . Shi, Zuo, and Zillante (2012, p. 426) argue that sustainable construction is the response to sustainable development requirements by the construction industry.

Construction has been negatively associated with impacts on:

> "the environment such as soil erosion and sedimentation, flash floods, destruction of vegetation [landslide, deforestation, soil erosion] and dust pollution, depletion of natural resources and the use of building materials harmful to human health (Construction Industry Development Board (CIDB) Malaysia, 2007a)" (Abidin, 2010, p. 421).

Sustainable construction can be described as construction with sustainability in mind from the land, building, user behaviour and facilities interface and includes everything to support green buildings and facilities from inception to demolition / recycling. The aim of sustainable construction is net-zero construction meaning that it has no impact on the environment, and positive impacts on society and the economy. The Green Building Council of South Africa (GBCSA) describes sustainable construction as:

> "Sustainable Construction practices incorporates design, construction and operational practices that significantly reduce or eliminate the negative impact on the environment, society and the economy" (Milne, 2012, p. 27).

Aspects of sustainable construction has been framed by the International Organisation for Standardisation (ISO) as construction that takes into consideration environmental aspects (reduces emissions to air, use of renewable material, reduces freshwater consumption, reduces waste generation, considers the change in land use), economic aspects (adaptability, serviceability, costs and maintainability) and socio-cultural aspects (access to services, accessibility, indoor conditions, air quality, aesthetic quality and safety). ISO 21 929-2 outlines a framework for the development of indicators for civil engineering works that is a good reference point for land conversion developers and real estate actors that deals with economic aspects (life cycle costs and other external costs) environmental aspects such as GHG emissions, material use, water use, energy use, waste production, eutrophication potential, acidification potential, ozone depletion potential and land use change) as well as social aspects such as health and safety, job creation, cultural heritage, access to nature, urban sprawl, public acceptability and aesthetic value.

The Institute for Sustainable Infrastructure (ISI) has created "Envision [v3] as a tool for infrastructural projects of all types, sizes, complexities and locations. Envision allows individuals to increase the level of personal impact they can have on projects sustainability and in the process increase their value to not only their organisation but their broader community". Envision v3 project teams may choose to pursue one of two verification pathways. Pathway A: design and post construction; Pathway B: Post-construction. Envision v3 establishes credit award system relating to quality of life, leadership, resource allocation (materials, energy and water), natural world (siting, conservation and ecology) and climate and resilience. In this paper the application of these principles will be explored in the land conversion phase of development.

GhaffarianHoseini et al. (2013) argues that the environmental impact of buildings can be most felt though energy use, atmospheric emissions, raw material usage, solid waste generation, water use, water effluents (in ranked order) and to a lesser degree other releases and land use. Energy use and atmospheric emissions have the most negative consequences and therefore require most urgent action and innovative solutions. The "[r]ole of building materials, location, energy usage, construction process and waste management as significant parameters of sustainable energy performance indicators for industrial buildings" (GhaffarianHoseini et al., 2013, p. 8). Sustainable energy performance is measured in terms of operational energy performance as well as embodied energy consumption (i.e. mining, manufacturing, on site process, packaging, transportation and final disposal).

2.11 Sustainable / Green Procurement

The sustainable / green procurement lifecycle stages in the material manufacturing section includes: “raw material extraction, material transportation, manufacturing, product packaging, storage and handling to product use and disposal (or recycling)” (Wong, San Chan, & Wadu, 2016, p. 860). ““Sustainable purchasing”, “responsible purchasing/sourcing”, “green purchasing”, “ethical procurement” and “supply chain sustainability” are some of the myriad titles of such initiatives” (Harris & Divakarla, 2017, p. 1604).

According to the International Organisation for Standardization “sustainable procurement (SP) that delivers long-term social, economic and environmental benefits… contributes to the achievement of organisational sustainability objectives and goals” (ISO 20400). ISO 20 400 defines sustainable procurement as “procurement that has the most positive environmental, social and economic impacts on a whole life basis” (Harris & Divakarla, 2017, p. 1604).

The International Organization for Standardization (ISO 26000:2010) in principle outlines seven core subjects of sustainable procurement. The principles are:1)” organisational governance, 2) human rights, 3) labour practices, 4) the environment, 5) fair operating practices, 6) consumer issues, 7) community involvement and development” (International Organisation for Standardization (ISO), 2010). Organisation governance refers to a decision-making process of what and how to procure. It also refers to the organisational governance structures that make sustainable procurement possible. The second principle, human rights, requires that matters such as resolving grievances, social and cultural rights and discriminatory practices against vulnerable groups are considered. In addition, the third principle, labour practices, outlined in ISO 20400 challenges organisations to adopt and consider fair labour practices, health and safety at work as well as human development and training in the workplace. The fourth principle of sustainable procurement requires organisations to consider the environment through the use of and consideration of sustainable materials and resources, restoration of natural habitats, the prevention of pollution, sensitivity towards biodiversity and climate change. The fifth principle, fair operating practices, requires that anti-corruption and fair competition is promoted. It requires a consideration of “responsible political involvement” that promotes sustainability in the real estate value chain. It further advocates as a sixth principle, the consideration of fair marketing and contractual practices as well as the protection of consumer data. The seventh principle is closely linked with social responsibility (ISO 26 000) and requires the consideration of community involvement, development and education in the procurement phase of the real estate value chain. Sustainable construction in the real estate value chain requires the consideration of life cycle costs and life cycle analysis in land conversion planning and development activities and is discussed next.

2.12 Life Cycle Analysis vs. Life Cycle Costing

Sustainable construction is concerned with life cycle cost (LCC) optimisation (Shi et al., 2013). To assist with sustainable construction, "a life cycle approach should be considered during the assessment of relevant costs and impact" (Shi et al., 2013, p. 2). "[A] lifecycle approach should be considered when assessing the effects of construction activities and the performance of buildings on the environment" (Shi et al., 2012, p. 426). Heralova (2017, p. 565) submit that the traditional approach of using construction cost minimisation should instead be replaced with LCC optimisation". This means all costs incurred over the whole life cycle of the structure must be considered to evaluate and achieve the maximum value for money. Life cycle costing is a method of economic analysis directed at all costs related to construction, operating and maintenance of a construction project over a defined period.

> "Life cycle cost in general consists of an initial investment (usually construction costs) and the follow-on costs (ordinary payments, energy, utilities, cleaning and maintenance, irregular costs for renewal or replacement)" (Heralova, 2017, p. 566).

Other costs that must be taken into account are externalities (traffic congestion, pollution, dust reduction measures costs, light pollution reduction measures, noise reduction measures). Heralova (2017) argues that the early phases (programming and predesign) play a crucial role for the future performance of a building throughout the life cycle – at this early stage the optimisation potential can be enormous at a very small cost.

Bogenstätter (2000, p. 376) "points out that these early design stages influence up to 80% of building operational costs and environmental pollution". "In the later design phases, the possibility of change rapidly decreases with simultaneous increase[s] in costs" (Heralova, 2017, p. 566). The operating costs proceed to overstep the construction costs by a multiple. It is difficult to estimate the exact break-even point where the proportional incremental savings of operating costs exceeds the purchasing costs as this is dependent of the nature of the building, quality of construction and expected lifespan of the building (Heralova, 2017, p. 566).

> "By incorporating sustainability principles from the start of their projects, owners' subsequent decision making and practices are more likely to promote SC"(Abidin, 2010; Gan et al., 2015, p. 62).

Therefore, a major driving force for SC is from the Master Developer in the land conversion activities, representing the earliest participants in the real estate value chain (only preceded by the agricultural landowner as the farmer). Despite owners being regarded as key drivers, there seems to be an unwillingness for owners to shift from traditional construction to sustainable construction because of barriers. These barriers are created mainly by the lack of demand and increased requirements (Shi et al., 2013) and are the attention of this research paper.

Owners need to be shown, how an "integrated design process, including life cycle costing and optimisation, can significantly reduce operating and maintenance [cost] [(life cycle] costs)" (Heralova, 2017, p. 566) and in so doing significantly enhance the value of their real estate as well as the benefits of sustainable construction and green building. These benefits are described later in this paper. Myers, Reed, and Robinson (2008, p. 299) argue that the "lack of connection between sustainability and economic return affects the main stakeholders who invest in the property market, namely large financial, banking and superannuation" vehicle. Sustainable construction must be a prominent agenda item for land conversion participants and feature as part of corporate social responsibility strategies.

2.13 Sustainable Construction as part of Corporate Social Responsibility and Corporate Responsibility

Martens and Carvalho (2017) argue that organisations need to engage in Corporate Social Responsibility (CSR) activities to improve their social reputation. In addition, the triple-bottom-line principle suggests that positive financial gains can be obtained in the process of engaging in social behaviour and being environmentally responsible. Organizations can incorporate principles of sustainability into their activities by considering sustainability when strategies are being developed and reviewed, when new agreements are negotiated, supporting and promoting sustainability principles in new projects and expanding the vision of sustainability further than the company itself (Martens & Carvalho, 2017, p. 1086):

> "Corporate social responsibility is the continuing commitment by business to behave ethically and contribute to economic development while improving the quality of life of the workforce and their families as well as of the local community and society at large (WBCSD, The World Business Council for Sustainable Development, 2006, p.3)" (Martens & Carvalho, 2017, p. 1085).

The principles of corporate social responsibility directly apply to sustainable construction. The WBCSD places CSR as a subset of Corporate Responsibility (CR) carrying similar emphasis as sustainable development and apply equally to sustainable development and sustainable construction.

2.14 Corporate Responsibility

The World Business Council for Sustainable Development (WBCSD, The World Business Council for Sustainable Development, 2006) divides CR into corporate financial responsibility, corporate environmental responsibility, and corporate social responsibility. Principle 3 of the King IV Report of Corporate Governance™ Responsible Corporate Citizenship Recommended Practice 14 states "the governing body should oversee and monitor, on an ongoing basis, how the consequences of the organisations activities and outputs affect its status as a responsible corporate citizen" (Institute of

Directors Southern Africa, 2016, p. 45). Furthermore, the Institute of Directors South Africa (IODSA) require that:

> "organisations need to assess what impact they are having on critical aspects of society and the environment… an outcome which is contrary to that which society expects is inconsistent with good corporate citizenship and will result in the diminution of an organisations reputation, the trust in which it is held and the confidence society as a whole feels in it. Such a situation could well threaten the organisation's operational legitimacy" (Institute of Directors Southern Africa, 2016, p. 6).

Corporate citizenship in the workplace, economy, "society, public health, safety, consumer protection, community development and protection of human rights, environment, pollution, waste disposal and protection of biodiversity" is required.

Having outlined the basic definitions, components and concepts of sustainable construction in the real estate value chain it is necessary to describe the benefits of sustainable construction and green buildings as these benefits act as motivators towards a more sustainable future.

2.15 Benefits of sustainable construction and green buildings

Abidin (2010, p. 424) links "environment with economic aspects stating that with proper planning, environmental-friendly projects would be marketable and profitable". Abidin (2010) opined that sustainable construction leads to the "protection of the environment", a "prudent use of natural resources", "social progress for everyone", "maintaining economic growth", "quality of life and customer satisfaction", "environmental planning", "management and control"(Abidin, 2010, p. 424). By responding to the need to protect the environment this leads to addressing social needs and increases profits.

Insurance premiums may be lower when beneficiary's living conditions lead to healthier living. In addition, bank interest rates may be lower as result of lower risk due to increased productivity, lower tenant turnover, lower tenant churn, lower operating costs and higher residual valuation of sustainable or green star / ISO 14001 certification.

Some non-financial incentives such as expediting permitting and technical assistance save owners time by mitigating risk and process issues. In addition, when time is significantly lowered this leads to a substantial reduction in costs. When time and cost are reduced this lowers the risk associated with a project (Olubunmi et al., 2016, p. 1615).

Other benefits highlighted by various authors include:

- Reduced carbon emissions and lower operational costs, as well as increased rentals and capital values as well as social advantages (Vyas & Jha, 2018, pp. 108-109).

- “less time to secure tenants, lower turnover, better return on investment and higher building value partially because green buildings have a positive impact on employees’ health and productivity” (Hwang et al., 2017, p. 211).
- Complete functional tests are conducted of all energy systems prior to occupancy reduces maintenance costs (Vyas & Jha, 2018, p. 108).
- Improved environmental performance of real estate products (Liyin Shen, Zhang, & Long, 2017).
- Increased brand image, more business opportunities (Liyin Shen, Zhang, & Long, 2017, p. 160) (Hwang et al., 2017, p. 211) marketing benefits and prestige.
- Lower water consumption.
- Lower energy costs (up to 71% saving) (Dwaikat & Ali, 2018). According to estimates, “applying green wall materials and high energy efficient window products can help residential building save 33 – 60% and 14 -20% operational energy respectively” (Liyin Shen, Zhang, & Long, 2017, p. 160) as well as the “minimisation of operating cost by reduction in electricity consumption” (Vyas & Jha, 2018, p. 108) and the prudent use of natural resources. The International Energy Agency (IEA) lists the multiple benefits on energy efficiency as, on an international level: energy price reduction; greenhouse gas emissions reduction; the overarching benefit is the significant cost savings in energy bills (Dean, 2015).
- Improved indoor air quality and “greater comfort by creating a healthier indoor climate” (Vyas & Jha, 2018, p. 107).
- Enhanced health and productivity with decreased absenteeism (Vyas & Jha, 2018, p. 107) on an individual level: “lower energy bills (discretionary), increased disposable income, warmer, drier, more comfortable [buildings and] improved health and [wellbeing] potential” (Dean, 2015).
- Increased property value (Hwang et al., 2017, p. 211) between 4.1 -9.7% (Liyin Shen, Zhang, & Long, 2017, p. 162). Others have estimated an increase of between 18 -20% in value as well as an increase of building value directly correlated to energy saving (Vyas & Jha, 2018, p. 108). On a sectoral level there is an increase in re-sale value of properties (Dean, 2015).
- The construction of buildings that encompass green building practice yield solid financial returns and investment yields (Vyas & Jha, 2018, p. 107).
- There are also tax benefits that are offered by local, state or provincial and government authorities which act as incentives for green strategy implementation (Vyas & Jha, 2018). Vyas and Jha (2018) argue that the benefits of green building industry are tangible and measurable (Vyas & Jha, 2018).

- On a national level there are benefits such as “reduced energy demand and local price reduction, reduced public health spending, energy security, and potential net increase in employment” (Dean, 2015, p. 13).
- There is also improved bill payments for energy providers, jobs in installation and production of insultation materials.

As far as relating to land conversion urban planning and infrastructural developments, incorporating sustainable construction into precincts ensures that sustainable construction is catered for throughout the real estate value chain. Hwang et al. (2017) argue that mixed use developments and green business parks (GBP) create more established businesses, provide good jobs and thus from the perspective of the communities and social needs, are desirable. GBP take the environmental duty beyond individual organisation boundaries by promoting the closing of the material cycle and releasing pressure on the environment. Furthermore, the specialisation of certain industries and closer proximity offer agglomeration opportunities and competitive advantage leading to cleaner environments because of less transportation between businesses. This closer proximity nurtures an innovative and learning environment enhancing the economic and social development of communities, which attracts high return investments and concomitant decent jobs and economic growth in the local region. Hwang et al. (2017) submit further that GBP have the potential to advance the quality of life of the local community without the negative effects of development by reducing the waste and pollution through re-using resources and materials more than once before being discarded. GBP attempt to solve the conflict between the environment and the economy by increasing the infrastructure efficiency, reducing traffic congestion, improving water and air quality and thus reduce the burden on the environment and economic costs.

Green Business Park (GBP) lead to an increase in energy and waste exchange resulting in economic benefits for all parties. Hwang et al., (2017) opine that the reduction in operational costs and disposal costs lead to an increase in income from the sale of by-products.

Sustainable construction includes considering recycling facilities. From a building user perspective and space occupier, Collins and Junghans (2010) argue that tertiary churn and other problems are avoided by better transition process through for example facilities management (FM), sharing recycling facilities and better interaction with tenants through collaboration and coordination. “As a result of this building recycling rates increase to 70% as compared to the previous 40% as well as other cost reductions for all parties” (Collins & Junghans, 2015, p. 132).

The benefits of sustainable construction and green buildings have been described, it is necessary to understand the barriers and drivers of sustainable construction to enable the pursuit of the apparent numerous advantages.

2.16 Barriers to sustainable construction

Several building developers are unwilling to shift the boundary to sustainable construction from conventional construction for several reasons (discussed below), due to a lack of demand from the end-user. Consequently, this lack of demand from both the end user and the building developer results in a similar lack of supply of development land with mandatory sustainable construction specifications and requirements attached by the land conversion developer. To analyse the root cause of the lack of demand for sustainable construction by the land conversion developer it is necessary to understand the precedents (discussed below), as the land conversion developer is the residual participant that reacts to market forces in the user market, the financial market, the development market and collectively referred to as the macro economy. Government is the key player to shift this situation in the macro economy. However, the time lag to enforce stronger legislation and for these laws to be effected can be long. In addition, the unequal distribution of benefits between the user and the developer makes it difficult to convince the developer and the user to build green as each approach the subject with scepticism of the other.

Lack of enforcement and monitoring of law and legislation (Abidin, 2010, p. 425) is a barrier cited by Abidin et al. (2010) for the low level of implementation of sustainable construction. Information on database about green construction is not available to legislators and policy makers (Shi et al., 2013) leading to misinformed policies and regulations. Abidin (2010) however contends that government is still the key party that can redress this situation, but Liyin Shen, Zhang, and Long (2017, p. 161) contend that there is often “insufficient and ineffective government policies to support sustainable procurement”.

Barriers to sustainable construction requires a multipronged approach to overcome. Abidin (2010, p. 425) opine that the level of implementation of sustainable construction practices is either low or at a moderate level due to: 1) Lack of enforcement and monitoring of laws and legislation; 2) Lack of incentives for developers, contractors, consultants and buyers to pursue sustainability; 3) Lack of knowledge; 4) “At present it takes a longer time for stronger legislation enforcement to take effect”; 5) The time lag from applying principles to accessing the benefits from implementing sustainable practices (could be 2-3 years); and 6) lack of urgency. It is submitted by various authors that the pervasive barriers for all participants are related to the initial high cost of sustainable construction.

To develop a multipronged strategy to overcome the barriers to sustainable construction in the real estate value chain it is necessary to understand the barriers faced by each participant, before aggregating the interdependencies amongst participants. In essence, land conversion developers are reliant on demand from building developers, who are reliant on demand from end-users who are in turn reliant on a combination of legislation, conscience and consumer behaviour within the constraints of financial institutional requirements. The lack of demand by the end user (analysed separately for owners, investors, tenants and the public), building developers, financial institutions and land developers is expressed below.

2.16.1 Lack of demand by the end-user

2.16.1.1 Owners and Investors

Abidin (2010, p. 422) submits that, the lack of demand from the end-user is caused by a general lack of knowledge for environmental protection and social participation. Sustainable construction is not a priority as it lacks publicity and interest of potential buyers. User's need to be educated that by "responding to the need to protect the environment and address social needs they can generate more profit". In addition, Hwang et al. (2017) argue there is a general lack of understanding and awareness by the end-user and potential clients of sustainable construction and the benefits of green buildings.

Dwaikat and Ali (2018) submit that the lack of building owners' interest in the future costs and benefits of green buildings as well as the lack of proper education about green building practices and benefits are significant barriers for sustainable development and construction.

The integration and incorporation of sustainability in property valuation, investment and risk assessment decision and processes is obstructed by the lack of expertise and available data (Lorenz & Lützkendorf, 2008). This has the effect that owners as landlords are insufficiently informed of the benefit of sustainable construction and buildings. One primary research objective cited by Lorenz and Lutzendorf (2018) is therefore to demonstrate why and how socially responsible property investments enhance investment returns.

2.16.1.2 Tenants

Lack of marketing benefits is another barrier cited by many references. It has been submitted that the marketing benefits of sustainable construction and buildings needs to be communicated more in the public domain for to become mainstream (Liyin Shen, Zhang, & Long, 2017).

Hwang et al. (2017, p. 212) submit that there are "relatively very few [sustainable construction] sites which were engaged in measuring energy flows and exchanges. This leads to the difficulty in

demonstrating the positive environmental impact and benefits". This can be extended to include social impacts and other benefits to tenants.

There is also the view submitted by Collins and Junghans (2015, p. 132) that there is the "potential that green leases can also be hindered in their uptake if they disrupt or are burdensome to a tenants primary operations", this is amplified when the landlord provides little incentive for the tenant to increase the property asset value of the landlord at their own expense.

In addition, there is always the potential human nature conflict between the landlord and the tenant due to the unequal distribution of benefits between the landlord and the tenant when considering sustainable construction and green building principles. It is in this area that facilities management participants play a key role.

2.16.1.3 Public

Abidin (2010, p. 425) submits that the adoption of sustainable construction and green buildings "depends on the public interest and their willingness to pay a higher entry cost to enjoy such privilege". Similarly "sustainability demands also depend on the public interest and their willingness to pay higher entry costs to enjoy [the] privilege of the benefits of sustainability" (Abidin, 2010, p. 422). At present the main elements that makes green buildings expensive is that developers must imports these products or materials used.

> "The cost will reduce significantly if the products can be obtained locally. The respondents believed that until such products are made available locally and at a cheaper price, the progress towards sustainable practice will be slow" (Abidin, 2010, p. 425).

On the other hand, local manufacturers' interests in sustainable products and materials will only emerge "when there is market for it", until then, financial constraints will remain. "The inter-dependency among construction stakeholders will slow down the transformation towards a sustainable industry due to financial constraints" (Abidin, 2010, p. 425). Phuc et al. (2014, p. 2) "finds that the profits from land conversion are mostly seized by the developers and local authorities" and is another constraint to public adoption.

2.16.2 Lack of Demand from the Building Developers

The major barrier cited by most authors is the higher construction costs usually associated with sustainable construction and green buildings suggesting an increase of 8.5 – 13.9% of overall project investment (Liyin Shen, Zhang, & Long, 2017, p. 161). Vyas and Jha (2018, p. 107) argue that the higher initial construction costs, is strongly dependent the country's circumstances. Shen et. al. (2017) contend that developers and contractors give little attention to environmental performance when

procuring building materials and often purchase based on the lowest price (Liyin Shen, Zhang, & Long, 2017, p. 160). It is submitted that the additional increase by using green building materials trends to be exaggerated by professionals that are not actively engaged in green building (Liyin Shen, Zhang, & Long, 2017, p. 161).

It is contended by Vyas and Jha (2018, p. 107) that "the average increase in the initial cost of green buildings is 3.10% for those with three stars rating and 9.37% for those that are five stars rated buildings". It is worth noting the decreasing cost trend of sustainable construction over the last decade. Hwang et al. (2017, p. 212) argues that the:

> "perceived high costs compared with conventional buildings, which are mostly caused by special green materials, design, construction and maintenance, has become the most common barrier to the adoption of green buildings (Hwang and Tan, 2012; Kim et al., 2014; Zhang et al., 2011a, b). For an example, Davis Langdon (2007) reported that the impact on the construction cost ranged from 3% to 5% for a Five Star rating, and more than 5% for a Six Star non-iconic design solution in Australia"

Therefore, there is value in investing in such safeguard acts to protect the environment, at a marginal cost.

It is submitted by Vyas and Jha (2018) that energy efficiency measures account for most of the incremental cost of green buildings over conventional buildings. Orientation of the building, open window units, the position of doors and windows, proper insulation, proper plantation of trees, use of bamboo in construction are some of the conventional energy-efficiency methods (known as passive design or passive cooling strategies) that may be used and can reduce energy consumption by 20 – 30%. More studies are necessary for the initial cost prediction models for green buildings, especially to compare the sustainable building against conventional buildings. This is essential to consider the pros and cons calculated over the entire life cycle of the structure (from the cradle to the grave or more recently, cradle to cradle) of a green building in addition to determining the initial incremental cost of a green building at completion (Vyas & Jha, 2018). Vyas and Jha (2018, p. 109) argue further, that in many instances, initial costs of sustainable buildings can be lower than conventional methods, for example integrating shading for natural cooling, proper ventilation instead of an air conditioning systems and planting native landscape avoiding the need for expensive irrigation systems.

Coupled to this Vyas and Jha (2018, p. 108) argue that an important impact on the initial incremental cost of sustainable construction is government subsidies as the price and additional costs for early adopters is high. This is caused by factors such as there is no experience accessible for using the new material, sustainable procurement and implementing new design and construction process (Liyin

Shen, Zhang, & Long, 2017, p. 161) and therefore the risk of erosion of financial performance for developers.

Hwang et al. (2017, p. 212) submits, in support of the mentioned barriers, there are additional client barriers such as 1) lack of potential clients awareness and demand, variance of site practices compared to conventional methods leading to a higher risk level, 2) unequal distribution of advantages between developers and tenants, uncertain trade-off between environment and financial benefits; 3) project team barriers including lack of skilled labour in respect of green developments 4) consultants barriers in relation to lack of marketing and promotion 5) contractors barriers meaning the lack of the effective coordination between key players 6) project barriers such as complexity in obtaining green certifications and the lack of proven benefits to entice potential investors. The cost related to installations that conform to design specifications and higher labour costs are also cited as constraints. Most real estate players view sustainability concepts as an added burden in terms of time, cost and quality.

A change of mindset is possible if developers are shown examples of successful sustainable projects that add value to developments. As mentioned previously, successful sustainable construction projects depend on whether the public are willing to pay a higher initial cost to enjoy such privilege. One of the ingredients that make sustainable buildings expensive is the products or materials used, which currently are imported at a premium due to the transportation cost. The cost will reduce considerably if the products can be made locally. The respondents believed that until such products are available locally and cheaper, slow progress towards sustainable practice is inevitable. Local manufacturers' attention to green products will materialise when there is demand for it in the market. The “inter-dependency among construction stakeholders will slow down the transformation towards a sustainable industry” (Abidin, 2010, p. 425).

Design constraints are also cited as barriers to sustainable construction due to the lack of knowledge and skills, lack of exposure to sustainable construction in higher education studies, lack of experience in the real world (Häkkinen & Belloni, 2011), younger generation may have high education in sustainable construction but lack experience in real world, therefore the challenge of converting theoretical knowledge into practice (Abidin, 2010). In addition, the limited experience and ability of construction players know-how about the sustainability construction application, poor enforcement of legislation, education vs. experience paradox, passive culture and risk of certification timing are contributing factors. There is a poor general understanding of sustainable construction.

The unfamiliarity with cleantech and green technologies creates technical difficulties and delays in the design and construction process that could have a severe financial implication through penalties imposed by the client on the building and land developer (Hwang et al., 2017, p. 212).

Other barriers to sustainable construction and green buildings cited by Abidin (2010, p. 425) relate to further financial constraints due to the high cost of niche consultants, high costs of implementation, higher perceived upfront costs (e.g. energy plants, waste water treatment plants, higher costs mean higher prices for end user which is linked to lack of demand from end-users that want lower price). It is noted that this is not the case for well-established developer companies that target high income earners and foreign investors (Abidin, 2010).

The population of developers ranges from big to small companies. Most medium and small sized developers are expected to comply with the minimum existing standards as required by law. These firms tend to learn from experience and from larger firms, thus there is a two to three-year lag. "Only large firms [have] capacity to go beyond the minimum standard" (Abidin, 2010, p. 425) and are willing to adopt new technologies and innovation. The proportion of small to medium size firm is larger than the number of large firms, therefore it is expected that there will be a general lag in the implementation of sustainable construction practices that goes beyond the minimum standard. The current situation will remain since small and medium size organisations are not prepared for this paradigm shift whilst stronger legislation takes a long time to effect change. In the meantime, there will be the tendency that only larger organisations, with extra capital available for sustainable practices, to be interested (Abidin, 2010, p. 424).

Interdependency among construction stakeholders will slow down the transformation towards a sustainable construction industry. Another barrier cited by Liyin Shen, Zhang, and Long (2017, p. 161) is the "fragmented nature of the building supply chain and lack of knowledge between industry professionals about benefits of [sustainable construction] adoption". As mentioned earlier in this research paper, there is a general lack of suppliers and manufacturers of sustainable materials as well as equipment that is usually imported and supplied by contractors and are not made locally. Liyin Shen, Zhang, and Long (2017, p. 161) cited that "compatibility with other building products and components, higher additional cost, and higher material handling requirements during the construction stage are major barriers for developers to adopt [sustainable construction]" in the United States. Sustainable construction is considered an interdisciplinary issue involving professionals' various departments such as design, cost control management, and procurement, hence the efficiency of sustainable construction practices cannot be achieved by actions from isolated departments. In addition, Liyin Shen, Zhang, and Long (2017) argues that professionals' low environmental awareness

significantly slow the application of green building materials which is exasperated by “bad experiences with green building materials” has the potential to deter developers from adopting green procurement.

Hwang et al. (2017, p. 212) argues that “the lack of technical workforce and research funding to promote [sustainable construction]… [and] lack of human resources for eco-industrial parks and lack of professionals” as additional barriers. He further indicated that “technical difficulties during the construction process and the unfamiliarit[y] with green technologies resulted in delays in the design and construction process of green buildings” (Hwang et al., 2017, p. 212). These are referred to as “technology related barriers”. In addition, other barriers relate to technical concerns i.e. fire resistance, high requirements for good climate conditions during construction and poor durability. Standards need to be developed around these concerns. Learning from experience usually takes time both individually and collectively therefore since developers are profit driven, and short term, and follow market trends the conversion from conventional construction to sustainable construction will be slow. There is a strong correlation between implementation and the elimination of barriers.

Hwang et al. (2017, p. 213) also illustrated “that the lack of awareness and demand was chiefly due to insufficient statistical research affirming the significant lifecycle benefits and cost savings associated with green buildings”. In addition the “hard-to-find materials or creating cutting-edge designs [and after sales service] are barriers to sustainable construction and buildings” (Olubunmi et al., 2016, p. 1617). Liyin Shen, Zhang, and Long (2017, p. 162) contends that “some [green building materials] (GBMs) are not available and adopting green procurement (GP) incur additional cost due to the increase of transportation costs”. To compound this, is the lack of locally made green building materials which would ordinarily make a positive contribution to the social aspects of development (Vyas & Jha, 2018, p. 107).

Further to this, Olubunmi et al. (2016, p. 1617) cite “high fabrication to meet crucial LEED requirements.. [and] the incentives provided by the government are often nullified by the [prohibitive] cost involved in certification”. Wong et al. (2016, p. 860) states that the “current bureaucracy toward solving environmental problems has resulted in a lack of incentives to adopt green procurement in construction”.

Liyin Shen, Zhang, and Long (2017, p. 162) submits the typical barriers of green procurement as:

> “lack of incentives from the government, cost increase, technical concerns with using green building materials lack of expertise on applying green building materials, lack of environmental missions and strategies within organization, no clear definition on environmental responsibilities between departments within organization, low environmental awareness between managerial staff, bad

> experiences on purchasing green building materials, low environmental awareness between housing consumers, lack of attractiveness of green building materials to consumers, lack of authoritative green building materials certification system, poor information dissemination on green building materials in market, unavailability of green building materials in local market."

Liyin Shen, Zhang, and Long (2017, p. 166) argue that the implementation and enthusiasm for green procurement and green buildings is deterred by the low demand for GBMs. Furthermore, Hwang et al. (2017) submit that the lack of comprehensive research of the actual obstacles of sustainable construction and the absence of a green building project management framework significantly limits interest in sustainable construction.

Developers, contractors, consultants, suppliers and buyers have an influence over the application of sustainable concepts. Hwang et al. (2017, p. 212) point out that when there is an unequal distribution of gains and advantages between the developer and the tenant, or the green building costs can't be transferred to the tenant easily it is hard to influence and persuade the developer to construct green structures and buildings. The "uncertainty of the trade-off between environmental and financial benefits is a barrier making the investors hesitate to step to green".

Shen et al. (2017) argue that few developers in China had environmental strategies and missions and some even ignored and resisted environmental initiatives. Consequently, due to the lack of top management support for implementing green procurement this is considered a significant barrier to sustainable procurement and construction.

Due to the risk of producing an unsellable unit, in the potential world economic meltdown as in the 2008 Global Financial Crisis (GFC), developers are afraid to build expensive buildings.

> "The respondents stated that all players (developers, consultants, contractors, local authorities, manufacturers and purchasers) have a role to play to ensure that the project activities have minimal impacts on the environment"(Abidin, 2010, p. 425).

Abidin (2010) submits in order to ensure commitment and participation in achieving and implementing sustainable construction, the knowledge of all players must be improved.

2.16.3 Lack of Demand from Financial Institutions / Funders and Insurance Houses

Hwang et al. (2017, p. 213) has illustrated "that the lack of awareness and demand was chiefly due to insufficient statistical research affirming the significant lifecycle benefits and cost savings associated with green buildings", consequently impacting insurers through a lack of awareness of risk adjustment premium to be applied to sustainable construction and green buildings. In addition, the lack of law,

legislation and regulations enforcement affects the risk levels and ultimately the premium and decision whether to extend insurance and underwrite the project.

The lack of technical workforce and research funding to promote sustainable construction and the availability of specialist consultant that are experts in the field of sustainable construction means that the risk adjusted premium may be arbitrarily applied and therefore inaccurately reflect the level of risk involved. Variance from conventional construction leads to higher risk, and higher premiums in construction works insurance. Due to the higher initial cost of the building it is surmised that this may increase insurance premiums.

A further barrier to sustainable construction in the real estate value chain is the apparent lack of proven benefit to investors, that may lead banking institution to apply the incorrect interest rate to project resulting in an overstated and / or overlooked risk premium.

2.16.4 Lack of Demand from the Land Developer

Lack of green / sustainable concepts at the master planning stage, as early as possible, is a barrier. Having sustainability elements explicit in the masterplan as early as possible make it easier to propose green building concepts, green materials, green design or green systems for the project (Abidin, 2010, p. 425). Retrofitting can be expensive whilst green consultants are usually imported at a premium.

On the positive side, aggregates and gravel are usually available locally for road construction and infrastructural projects products such as roads, curbs, culvert and storm piping concrete can be made locally. Streetlights, security equipment manufactured, solar components and renewable energy (solar, wind, wave etc.) as well as water treatment plants, however, are not made locally and must be imported at present. Local manufacturers will only be interested in introducing green products when the market is potentially lucrative. Until this happens progress will be slow towards sustainable construction. In addition, the “knowledge of all players must be improved to ensure commitment, implementation and participation in achieving sustainable construction” (Abidin, 2010, p. 425).

There is very little written, and a general lack of information, in the literature regarding the barriers to sustainable construction from the perspective of the land conversion developer, and therefore has become the focus of this research.

2.17 Summary of literature review

The literature review commenced with a study of the real estate value chain and understanding the major players in the real estate value chain. Subsequently, a study of sustainable construction was undertaken by analysing the various components of sustainability. These components include economic sustainability, environmental sustainability and social sustainability (collectively referred to

as the triple-bottom-line dimensions). Sustainable development is another dimension of sustainability, and was studied, since sustainable construction needs to be understood within the broader concept of sustainable development. Having understood and broadly defined sustainable construction it is necessary to analyse the interlink of sustainable buildings, green procurement and life cycle analysis and costing with corporate responsibility since, to a large extent, sustainable construction and development can only be brought into the mainstream when this becomes a mainstream theme in corporate strategies, missions and objectives.

A summary of the literature is, as supported by Abidin (2010), that many developers generally are aware of sustainable construction, but deficiencies were identified in the implementation thereof. Several developers were unwilling to push the limits especially when it requires shifting from traditional construction and to technology and practices that were unfamiliar which may incur more initial costs. Several developers were satisfied with meeting the minimum standards and law requirements while few developers will take initiatives to better practices and follow market trends.

The benefits of sustainable construction and sustainable buildings were identified as possible motivators to a more sustainable future before trying to analyse the barriers and constraints for sustainable construction.

Chapter 3: Methodology

3.1 Introduction

The aim of this chapter is to describe the approach followed to respond to the research question posed in section 1.3. Section 3.1 commences by recapping the research question and describes the method and measures by which the research question is answered. Section 3.2 describes the philosophical position of the research, whilst section 3.3 outlines the research approach before highlighting the unit of analysis and research technique in section 3.4 and 3.5 respectively. Section 3.6 highlights the sampling technique applied whilst section 3.7 describes the data collection and analysis methodology. Lastly, the ethical issues and research limitations are discussed in section 3.8 and 3.9 respectively.

This research examines the level of knowledge and understanding of sustainable construction among real estate actors with primary focus in Durban, South Africa. Three preliminary projects were initially used to investigate the level of awareness, knowledge and implementation of sustainable construction based on the perceptions of project developers, owners, urban designers and professional consultants in the land conversion process in South Africa. The project teams that were surveyed were professionals that were involved in the Kwa-Zulu Natal region with the survey focused on land developments located in Durban, South Africa (main metropolis for port cargo handling in Africa). The Durban metropolis was selected as this is an economic hub for the Kwa-Zulu Natal Province and also an important city within the South African context being the second largest economic hub in South Africa. The northern corridor of the Durban area was selected because many developers have selected unique real estate development opportunities, with new developments within the metropolis expanding mainly into the northern corridor of the metropolis. The list of expert interviewees was then selected from the professional firms using the snowballing sampling technique. A total of 27 respondents was received. Eleven responded to the online survey, and 16 responded after making telephonic contact, of which 9 agreed to a recorded interview.

3.2 Philosophical position of the research

The choice of the research approach was partially constrained by the timing of the research and the limited responses received. These practical constraints limited the quantitative data that could not be relied on completely because of the limited number of respondents. The qualitative research commenced with pilot interviews of experts in the land conversion process whilst concurrently sending and following up the survey questionnaires. Upon stagnation in the survey process, targeted experts were approached for interviews. A response from every professional in the land conversion process was not possible.

The quantitative research preceded the qualitative research in the sequence of decision making but carried equal weighting in the findings as the qualitative findings enriched the quantitative results. The quantitative research was the dominant method in the conduct of the research (initially), but due to the limited responses and availability of suitably qualified respondents, the research then shifted to a more qualitative research approach as the research progressed.

The research aimed to determine what are the barriers and constraints to sustainable construction in the land conversion process of the real estate value chain. At this point it is important to highlight that to answer the "what" question it is important to interview respondents to obtain a better understanding of the "what" and "why". It is for this reason that the mixed method approach was adopted for this research. In more specific detail an explanatory sequential design was followed which entailed quantitative research using questionnaires, which were explained or elaborated by conducting qualitative interviews to enrich the findings.

This method involves collecting and analysing quantitative data which is followed by qualitative data that is collected and analysed to explain the quantitative data or to provide richer context (Bryman & Bell, 2015). In the research, the qualitative research acted as backup and follow up of the quantitative findings. The phasing of the data collection was concurrent and sequential in that the quantitative data was collected first, along with pilot interviews prior to the qualitative collection of data.

There are various interpretive methods available for qualitative research and is dependent on the contexts of the research. It is also dependent on the type of information that is needed to respond and answer the research question posed. In addition, the credibility of the information source is another factor that was considered.

To answer the research question and achieve this, it was necessary to survey and interview developers, urban designers, professional consultants and experts in green buildings and precincts using a mixed method study methodology.

3.3 Mixed Methods Methodology

3.3.1 Overview

The mixed method study approach was used in this research as the overarching methodology, to gain an appreciation of sustainable construction in the real estate value chain with focus on major land conversion projects completed and scheduled to begin in 2018 / 19. The results of the studies, surveys and interviews was analysed to inform the analysis and results.

3.3.2 Mixed Method versus Qualitative and Quantitative Research

The mixed methods study is most appropriate for a study of the barriers of sustainable construction in the land conversion sector of the real estate value chain since the study of sustainable construction is still in its infancy and there is a limited pool of professionals involved in land conversion projects. These factors limit the possibility of a pure quantitative study as the potential population of land conversion professionals and experts is limited and further limited by the senior level of individuals with the experience required in order to answer the research question.

3.4 Unit of analysis

The surveys and interviews targeted the core land conversion design team (i.e. Research and Marketing Executives, Development Managers, Project Managers, Urban Designers, Town Planners, Quantity Surveyors as procurement experts, Consulting Structural Engineers, Civil Engineers, Landscape Architects, Architects, Environmental Assessment Managers and Social Impact Assessment Managers), and the core development execution team in the land conversion development sector.

The unit of analysis in this research is senior levels of individuals with experience in land conversion activities.

3.5 Research Design

Survey-based research methods are becoming the more common method of data collection used in this field. The results of the literature review show that the study of sustainable construction is still in the discovery stage. This is consistent with Martens & Carvalho (2017).

Allen & Seaman (2007) argue that, as a general rule, parametric analysis that is based on normal distribution is invalid for ordinal scales such as Likert scale analysis. Non-parametric procedures which are distribution free and which are based on the rank, median, range, frequencies and tabulations, are appropriate for analysing this data. Where the participants provided additional information in the questionnaire, no conclusions were derived from the additional analysis due to the subjective nature of the categorisation and classification. The results, however, were used to provide richer context and understanding of the current barriers to sustainable construction in the real estate value chain and to suggest strategies to overcome these barriers.

When using Likert-type scales, Giliem and Gliem (2003) argue that “it is imperative to calculate and report Cronbach’s alpha coefficient for internal consistency reliability for any scales or subscales one may be using” (Gliem & Gliem, 2003, p. 88). Pallant (2013) submits that Cronbach’s alpha coefficient is one of the most commonly used measures of internal consistency, and measures the extent to which items that make up the scale are unison (Pallant, 2013). If there is no consistency, the reliability of the

results is doubtful and / or unknown. Cronbach's alpha reliability estimates must be used for two or more independent groups and cannot be used for single groups (Gliem & Gliem, 2003).

3.5.1 Design of Questionnaire

A structured literature review was performed to identify a list of probable barriers and drivers, which was validated with surveys with industry professionals, developers and owners. The literature was screened and classified using mind maps to separate the literature into themes and topics for further analysis using survey-based questionnaires. The research questionnaire was developed from the literature review and using a pilot interview, with predominantly open questions, to gain an appreciation of the scope of the sustainable construction concept. Initially the questionnaire was piloted and pre-tested with a small group of core design team professionals, to make sure that questions, scales and instructions are comprehensive (Pallant, 2013). A pilot interviews with pilot participants was followed by survey questionnaires to obtain the stakeholders opinions of the relative importance of each barrier or driver. To supplement this a range of closed questions on a 5-points perception scale ranging from 1 (not at all) to 5 (to a great extent) was used. For each variable discovered from the interviewee and respondents, the results are summarised in the findings at the end of this research. The research instrument was validated to form the research questionnaire that was then posted online through SurveyMonkey® via email with a link to the questionnaire.

Sometimes it is not possible to guess all the possible responses and therefore open questions were used in the pilot interviews. The advantage of open questions is that respondents were not restricted by the researcher and had the "freedom to respond" as they liked. Responses to open-ended questions were summarised into distinct numbers representing a specific category (Pallant, 2013). These categories were established after reviewing the range of responses received from respondents and an understanding of the previous literature review performed, for entry into IBM SPSS. Open questions responses were sorted into themes and coded for analysis. At times a combination of opened and closed questions was provided to give the respondents an additional category (i.e. "other"), to provide respondents with a response option that was not provided for in the closed questions, to respond as they wished.

The questionnaire method used were self-completion questionnaire to the development team experts in the field, consisting of closed (with Likert scales options) and opened questions to encourage free expression and the option of collecting richer data. The survey and questionnaire style were drawn from similar research by Marten and Carvalho (2017) and presented below in table 1.

Table 1: Example Research Questionnaire

Research questionnaire: Example of the first question on three TBL dimensions.

You should choose one complex project finished recently that you took part of it. Respond what is the degree of usage that answers the statement bellow more appropriately. Similarly to the degree of importance.	Degree of usage (Is this issue really applied in your project?)	Degree of importance (The quality or state of being important: value or significance)
(ES1) The chosen project is evaluated with respect to financial and economic performance. Is it important? (Examples: return on investments, solvency, profitability, liquidity, liquidity, value added, profit sharing, market share, and gross domestic product)	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9
(ENS1) Natural resources are evaluated in the chosen project. Is it important? (Examples: reduction of resource use and waste production, recycling, reduction of impacts and soil contamination)	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9
(SS1) The management labor practices are applied to the selected project. Is it important? (Examples: health and safety, working conditions, training and education, employee relations, employment, diversity and opportunity, compensation, benefits, and career)	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9

Note: Scale varies from "1" "Totally disagree" to "9" "Totally agree."

Source: (Martens & Carvalho, 2017, p. 1095)

The research instruments used for this research paper has been a research questionnaire, and is provided in Appendix A, that collected background information about the details of the respondents including the primary occupation of the respondents, the number of years that the respondents had worked in the field of real estate and the sector that the respondents serviced predominantly. This information was necessary to frame the respondent's response received into classifications to understand the barriers experienced by the real estate sector and by profession and occupation. The main thrust of the research was to obtain an understanding of the various barriers to sustainable construction in the real estate value chain. It was divided into firstly, infrastructural questions and secondly, building related questions that related sustainability frameworks to sustainable construction. The first question that was asked was: what framework was most commonly used by professionals to determine infrastructural sustainable construction, development goals and objectives in the land conversion and development activities? The list of possible frameworks was obtained from the International Federation of Consulting Engineers (FIDIC) - Sustainable Infrastructure Rating and Certification Tools, accessed on the 12th January 2019. Respondents were then asked: To what extent they perceive the chosen framework, in question 1, as well as the extent to which alternative frameworks influenced infrastructural sustainable planning and construction.

A five-point Likert scale was used to measure respondents' perceptions and attitudes to the various frameworks on a rating scale of 1 = not at all, 3 = somewhat and 5 = to a great extent, with two and four inserted for somewhere between 1, 3, and 5 respectively. A "no opinion" of it option was also provided, as an option for those who did not have an opinion on the framework. Dawe (2008) argues that the most commonly used Likert scale used is the 5 – 7-point format. Allen and Seaman (2007) submit that Likert scales are commonly used for surveys and rank responses on five or seven levels from high to low or best to worst (Allen & Seaman, 2007). But the disadvantage of a 5 - 7-point Likert

scale is that many respondents are familiar with the 10-point scale. Therefore, the reliability and validity of results may be affected (Dawes, 2008).

A second set of questions was used, but this time directed at building and urban design. The top structure elements respondents were asked: what frameworks were most commonly used by professionals to determine building sustainability development goals in the planning and development activities of buildings. Again, the list of possible frameworks was obtained from the FIDIC. The respondents were asked to rate the perceived influence of the framework on sustainable planning and construction from 1 = not at all to 5 = to a great extent.

The main crux of the research, however, was to discover what the barriers of sustainable construction were. Respondents were asked to indicate using a scale of 1 = strongly disagree to 5 = strongly agree with the stated barrier. The stated barrier and style of establishing the degree to which they agree or disagree with the statement was extracted from the systematic literature review phase of this research paper. The final question asked respondents to suggest strategies that can be employed to further promote sustainable construction and overcome the barriers to sustainable construction in the real estate value chain, as an indicator for future research.

The 5-point Likert scale, as opposed to 3 or 4-scale, was used since it's allows a wider range of responses while being sufficiently concise to allow for more accurate analysis and computation purposes. For the extent of use of the framework and barriers, respondents were allowed the 6th option, = no opinion. This ranking possibility caters for the scenarios where the participants professional position does not use the framework or does not have the knowledge of the importance of the specific barrier.

Respondents were asked the number of years that they had been working in the field of real estate, to assess the experience of the respondent. In addition, the respondents were asked to indicate the sector of the real estate value chain that they predominantly serviced, to assess the trends from the results by sector. The sectors of the real estate were provided as:

- Retail;
- Commercial;
- Industrial;
- Hospitality;
- Offices;
- Residential;

- Educational;
- Government;
- Other

These sectors were obtained from EdgeBuilding.

3.5.2 Design of Interview Outline

The survey responses were followed by a semi-structured interview with experts to validate responses. The interviews followed the outline of the survey questionnaire structure, as provided in Appendix A, with the opportunity to obtain richer responses qualitatively. The interviewees were senior level experts from the land conversion sector.

The series of 9 interviews was conducted with well renowned sustainability experts from industry, the Green Building Council South Africa and ex- Directors of the Green Building Council. “A number between 6 and 12 participants is acceptable in this study as recommended by Johnson and Christen (2004)” (Abidin, 2010, p. 423). The interviews added to the survey’s conducted online and provided richer context to the responses already received. The data gathered was analyzed both quantitatively and qualitatively in mixed form. Likert scales and closed question responses were analyzed quantitatively whereas comments and statements were analyzed qualitatively.

3.6 Sampling

Sampling and data analysis were used for investigating key barriers for sustainable construction from the literature reviews based on the lenses of land conversion professionals and experts. The survey-based research was performed with the land conversion developer and the professional team. The size of the sample used considered the number of professionals in the development team of land conversion development projects and the relative size of the firm. Considering these parameters, a sample of 51 questionnaires were sent to respondents. The sample size was limited by the relatively small pool available of professionals involved in the land conversion process, and further limited by the population size that is unidentifiable. The respondents selected for this research were professionals responsible for the development design and execution of the land conversion developments. The contact list and respondents' profile were first generated through reviewing the websites of the 3 preliminary projects in the Durban Metropolitan area, north and west of the central business district (CBD) (as indicated in the research design section) and reviewing the management association website, as well as reviewing the “Chronicle” magazine for the names of firms involved in each development. Linkedin professional social media was also used and then corroborated with telephone calls to respondents (Martens & Carvalho, 2017). The desirable profile of the possible respondents was analyzed using the phases as recommended by Martens and Carvalho (2017) by

finding responsible experts in the LinkedIn network, then analyzing the responsible experts profile selected according to research profile desired (i.e. in this case senior individuals with land conversion experience). The available data on LinkedIn, such as job descriptions and job titles, was gathered to be used to obtain contact numbers of the relevant potential participants from websites, telephone books, contacts and other sources. The selected participants from each of the respective organization were then sent a link by email or directly from SurveyMonkey informing the selected individuals and professionals about the survey and asking about their interest to participate in the study. Therefore, 51 invitations were sent to selected professionals contact details with the desired profile with the request to complete the questionnaire online. This was carried out from March to July 2019.

A total of 51 respondents were approached by a SurveyMonkey™ survey and 11 responses were received, representing a 22% response rate. 16 responses were received after face-to-face or telephonic follow up. 9 interviews with experts in the field were conducted, recorded and transcribed for qualitative analysis. Thus, the total respondents equated to 27 participants.

When selecting the sample of participants to send the research instrument to, there were several factors and elements considered. It was decided that only professional managers and directors in each of the professional teams, developers and end-user firms would be selected to complete the questionnaire, since this are the participants that were key decision makers and stakeholders that had a significant influence on sustainable construction . Furthermore, the participants were limited to only those who had direct involvement in the land conversion development activities. These participants were selected due to their decision-making involvement in the land conversion development activities analysed and experience of barriers encountered when attempting to pursue sustainable construction.

The decision to focus on these participants is essential but explains the limited sample size due to the limited pool of professionals. The target for the unit of analysis was participants in the Kwa-Zulu Natal region and was further limited by the need for senior level individuals with land conversion experience to answer the research question. A more quantitative approach could be adopted, for future research, for a larger sample of industry participants to add credibility to the generalisability of findings.

The roles of the respective participants were requested, however the distribution was not limited to specific professionals. This was purposely done to make provision for additional insight from the data received. To make the process of identification simpler, respondents were given 30 project options roles to choose from. The roles presented were provided from a modified list extracted from EdgeBuilding, Excellence for Design for Greater Efficiencies webpage

(https://www.edgebuildings.com/edge-experts/online-training/). Participants that were considered to have the most influence in sustainable construction practices were expected to be:

- Developers and Owners;
- Architects;
- Consulting Engineers;
- Environmental Consultants;
- Landscape Architects;
- Urban Designers;
- Clients / Employer;
- Development Managers.

It has however been mentioned in the literature review section that the construction industry is an interdependent industry with many stakeholders, and thus the list was expanded to include other participants.

When choosing the sample size, the following firms were selected as participating firms: Iyer Urban Design, Hatch, SMEC, Bosch Projects, Sivest, Richard Kinvig & Associates, RHDV, Uys & White, Adamastor, One Planet Living, Bioregional, GAPP Architects and Urban Designers, ARUP Traffic Engineers, Hatch Bulk Infrastructure, Design for Abundance, WSP, Aurecon, Growthpoint and Aecom. These firms were selected from the available information provided on the 3 preliminary project websites as well as from further information gathered as the research progressed.

3.7 Data Collection and Analysis

IBM SPSS was then used to collate the data, store and perform the statistical analysis for interpretation (Martens & Carvalho, 2017). The data analysis was performed using the SPSS25 software.

“Preparing the codebook involves deciding (and documenting) how [to proceed with], defining and labelling each of the variables as well as assigning numbers to each of the possible responses” (Pallant, 2013, p. 11). The codebook is a list of variables used in the questionnaire, the abbreviations used in code names, and the codes ascribed to responses (i.e. the English name, the SPSS variable abbreviation and the coding instruction – code ascribed). Closed questions are likewise sorted, coded and analysed accordingly. In IBM SPSS “[e]ach response must be assigned a numerical code before it can be entered” (Pallant, 2013, p. 13). The codebook used is provided in Appendix B. For closed questions the convention is decided on and stuck to (i.e. first response is list coded as 1 and ascended for second, third and onwards to other=99).

Upon receipt of all the participants responses the overall significance of each barrier was calculated using SPSS. A field was also provided for participants to list additional frameworks and barriers to sustainable construction which may have been missed during the literature review. This qualitative result was used to collect additional information with the results subjectively coded and classified into the existing categories or a new barrier identified.

The qualitative evidence obtained from the interview and surveys were analysed, into themes and nodes, to present the most crucial factors inhibiting the adoption of SC practices. The results can be used to inform policymakers, owners and stakeholders of measures necessary to remove the barriers impeding more SC practices. Further research is necessary to determine what strategies agricultural land conversion participants can develop to ensure that sustainable construction is applied throughout the real estate value chain.

As mentioned in 3.5 above, reliability measures the degree to which the "result of a study are repeatable" and whether the resulting concepts are consistent (Bryman & Bell, 2015) and is often used in connection with quantitative research to measure whether the results are stable or not. The sample size of the respondents was too small to perform any form of reliability calculation and would not provide an accurate measure of reliability.

A more important criterion of research is validity. Validity is primarily focused on the "integrity of conditions" that are reached during the research (Bryman & Bell, 2015). It measures whether or not a measurement devised really reflects the concept that is denoted in the results and conclusions. Validity answers the question of whether the measures really represent the concepts portrayed. If it is unstable or fluctuates it will be unreliable and not valid. In the research question the casual relationship between the barriers to sustainable construction is not measured and hence no internal validity measured. The sample size was too small to measure the external validity to be able to generalise beyond the context of the specific research undertaken. According to Bryman and Bell (2015), "[e]xternal validity may be relevant to qualitative research but limited by the preoccupation with maximising the opportunity for a representative sample". It is argued that some writers have tried to apply the validity and reliability concepts to qualitative research but because these concepts are grounded in quantitative research it renders them irrelevant, inappropriate and inapplicable to qualitative research. It is submitted that trustworthiness is a more appropriate criteria for qualitative research which measures credibility (how believable are the findings), transferability (do the findings apply to other context), dependability (timing - are the findings likely to apply to other times) and confirmability (have the values of the researcher intruded to a high degree) (Bryman & Bell, 2015).

Qualitative research is provided in the context of a naturalistic stance, which is less directive than quantitative research. Reliability has three prominent factors mainly: stability over time, and that results relating to the measure do not fluctuate even if applied to the same respondents over time, there will be little variation. The second factor is internal reliability (i.e. whether individual scores of respondents will tend to relate to other score indicators). The third factor is inter-rater reliability (Bryman & Bell, 2015) which is not discuss and outside of the scope of this research.

The test of stability was not performed in this research as it would require measuring the responses and remeasuring it sometime later. It is argued that "many if not most research findings do not carry out tests of stability (Bryman & Bell, 2015, p. 168) and is more suited to longitudinal studies. A Cronbach's alpha co-efficient of the barriers to sustainable construction was calculated to be 0.961 for the 27 cases processed, of which 14 cases were excluded for lack of complete data or "no opinion" answers. This means that the barriers to sustainable construction has good internal consistency, with an Cronbach alpha coefficient reported and the reliability of the measure high. A figure of 0.8 is typically accepted as the rule of thumb to indicate an acceptable level of internal reliability (Bryman & Bell, 2015). Pallant (2013) recommends a minimum level of 0.7. However, the sample size of the respondents was too small to perform any form of reliability calculation and would not provide an accurate measure of reliability.

There are various methods of establishing validity, such as face validity (in which experts are asked to evaluate intuitively whether the results make sense on face-value), concurrent validity, predictive validity (where respondents are asked their level of agreement or disagreement with a statement. This measure was used extensively in the research as a test of predictive validity of the scale to find the relationship between the various barriers.

In the qualitative section of the research the reliability and validity measure were adapted to include credibility (the method often recommended for this is triangulation), transferability, dependability and confirmability (i.e. trustworthy and authenticity tests). External reliability measures were not performed as it is impossible to "freeze" the setting and context to make it replicable as required for external reliability testing and would not be comparable to the original research.

This research had a focus on depth rather than breadth that is often the preoccupation in quantitative research, and was oriented to the contextual uniqueness and significance of the aspects studied and provided "thick descriptions" of the views of experts in the field of sustainable construction in land conversion. The method of triangulation was also applied in that the results of the quantitative survey were validated and verified by interview with experts. This qualitative research entailed an intensive

study of a small group of specialised respondents that shared the characteristic of land conversion experience and expert knowledge in sustainability.

Yardley (2000) has proposed an alternative to reliability and validity for qualitative investigations should rather be: sensitivity to context, commitment and rigour (and extensive engagement with respondents that have the necessary skills and through data collection and analysis, transparency and coherence (in that the method is clear and the argument is clearly specified) and lastly the impact and importance (Bryman & Bell, 2015).

Closed questions responses were convert to the numerical format required for IBM SPSS, numbering each of the possible responses into numerical code (Pallant, 2013). A codebook has been provided in the appendices to illustrate the entire process of converting the information obtained from each respondent into the format required by IBM SPSS.

The empirical data was collected through questionnaire surveys to land conversion real estate developers and professionals involved, to identify sustainable construction barriers. Subsequently, to interpret the responses and results of the questionnaire survey, semi-structured interviews were conducted to verify, validate and interpret the responses. This is consistent with the approach adopted by Liyin Shen, Zhang and Long (2017). The responses from both the surveys and the semi-structured interviews were collated and summarised as the major barriers to sustainable construction.

Likert scale is a commonly-used research instrument to assess ordinal data, such as the respondent's perception of an attitude to the various frameworks that has been chosen. This has been the preferred method used similarly by various authors such as Marten and Carvalho (2017). The common barriers to sustainable construction are portrayed in table 3 in chapter 4. The summarised version of these barriers is found in Figure 4 & 5 in Chapter 4.

As mentioned earlier, an electronic survey instrument was sent, using SurveyMonkey™, to participants and supplemented with interviews with experts in the field. The advantages of using electronic web-based surveys includes access to greater number of participants, anonymity, time and cost savings in travelling and distribution. Stanton (1998) found that online surveys reduced the number of missing values as compared paper-based versions. In addition, to improve sampling the costs and benefits of using access controls such as passwords and authentication was considered by Stanton (1998). The disadvantage of using online surveys, as highlighted by Stanton (1998), related to consistency and participant motivation problems (Stanton, 1998, p. 711).

Using Survey Monkey™ as the survey medium, overcomes the access control, distribution and access considerations that Stanton (1998) raised but argues that emails to targeted individuals can also be

solicited. However, the disadvantage with emails is that anonymity is lost, and it may be therefore difficult to erase the lingering suspicion subsequently. The use of access controls such as passwords and authentication keys, however, creates suspicion in participants about confidentiality, traceability and anonymity. The survey sent to participants is provided in appendix A, including the Likert scale research instrument.

The desires of developers, urban designers and professional consultants were measured against the actual implementation to understand the barriers, elements, gaps and enabling factors influencing sustainable construction in the land conversion process of the real estate value chain.

3.8 Ethical Issues

The research required the consent of respondents in anonymity and confidentiality, as well as the use of results when interviews were carried out (the sample information sheet and consent form has been provided in Appendix C). In addition, questionnaires completed by employees and professionals may be concerned of their future career and business development prospects. The research obtained the consent of all interviewed as far as practically possible.

To verify, validate and interpret the results of the survey the outcome of the results was analysed to provide an indication of the major barriers of sustainable construction, for further research, to provide suggestions for mitigating those significant barriers in promoting sustainable construction / green procurement.

A copy of the signed ethics clearance form is provided in Appendix F.

3.9 Limitations

The land conversion developments used in this research, are limited to below the ground sustainable construction practices and infrastructure. It does not extend to the construction of the top structure, occupation and continued maintenance of the building although certain end-user participants were included in the study in recognition of the interdependency of real estate players. Furthermore, mixed methods methodology is also limiting in the generalisability of the results.

Some questionnaires in the validation process are self-administered and therefore this can introduce ambiguity / variety as to the validity of data provided. To overcome this ambiguity in the questionnaires, pilot interviews were conducted to reduce ambiguity and avoid leading questions, prior to sending the research instrument to participants. Semi-structured interviews have been conducted and personal interviews were conducted to validate the questionnaires and surveys (Bryman & Bell, 2015).

This dissertation has a focus on the agricultural land conversion cycles in the real estate value chain, from planning of the conversion of land from agricultural use to urban land use. It excludes building construction to intensive urban development and excludes when the building is completed and occupied. In addition, the quantitative surveys were carried out in the Durban Metropolitan area, north and west of the central business district (CBD) but was supplemented with telephonic and social media-based interviews with experts from other areas.

3.10 Conclusion

The aim of chapter 3 was to describe the mixed method approach followed to discover the barriers and constraints to sustainable construction in the land conversion process of the real estate value chain, commencing with a recap of the research question and described the method and measures by which the research question was answered, in section 3.1.

Section 3.2 described the philosophical position of the research whilst section 3.3 described why the mixed method research approach was adopted, instead of other research methodologies, before highlighting the unit of analysis and research technique in section 3.4 and 3.5 respectively. The sampling technique, data collection and analysis methodology were discussed in section 3.6 and 3.7, before summarising the ethical issues and limitations in section 3.8 and 3.9 respectively.

CHAPTER 4: RESULTS AND DISCUSSION OF FINDINGS

Primary research findings

This chapter summarise the results of the survey responses. The un-modified sample result can be found in the Appendix D, as an example, that reflects each participant's response identification, occupation, years' service in the industry, sector, infrastructure frameworks used by land conversion participants for sustainable construction, infrastructure framework influence on sustainable construction, building framework most used by real estate participants, building framework influence on land conversion, barriers to sustainable construction in the real estate value chain.

Section 4.1 provides an overview of the respondent profile, highlighting the occupation, years' service in the industry, the sector experience of the professional respondents. Section 4.2 summarises the primary research results, section 4.3 indicates the qualitative findings and section 4.4. provides the additional research results and section 4.5 provides preliminary strategies that can be employed to promote sustainable construction and overcome some of the barriers identified.

4.1 Participant Demographics

After all the participants responses were received, the overall importance of each barrier was calculated using SPSS. The total number of responses received was 27 and the total number of no opinion responses was excluded from the survey results. The responses received were ranked by perceived relative importance of each particulate barrier to sustainable construction, according to the mean item scores using IBM SPSS. The exclusion number of no opinion responses provides a means to calculate the normalised importance of each barrier, as it considers those participants that were not able to provide an opinion of a specific barriers or framework, and thus allows a comparison of each barrier's relative importance. The survey was sent to 51 respondent, all that had knowledge of the land conversion development projects. The respondents included the full spectrum of professionals involved in the real estate value chain including developers / owners, project managers, engineers, architect and urban designers, environmental and sustainability consultant as well as town planners, financial services, and development managers, green building council and therefore representative of the dataset for the land conversion real estate value chain. Of these respondents, 11 responses were received online via SurveyMonkey™. A further sample of respondents were sought by contacting professionals and experts in the field of sustainable development, which led to a further snowball sample whereby additional respondents were suggested by these professionals and experts during the interview. The contacted professionals were contacted for an interview and simultaneously the survey was completed. A total of 16 surveys were completed telephonically, of these 9 interviews

were recorded, transcribed and used for the qualitative evidence required. The occupations of the respondents varied and included 4 developers / owners, 3 project managers, 3 civil engineers, 3 environmental consultants and various other participants in the land conversion real estate value chain as represented in figure 2 below. Developers / owners represented the most respondents.

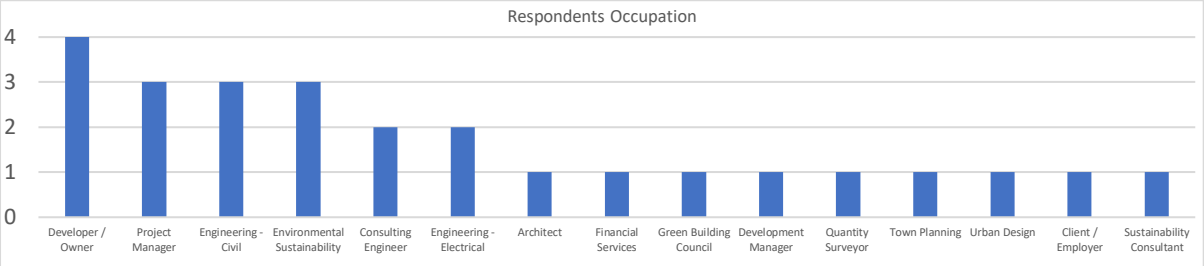

Figure 2: Respondents Occupation

The combined experience of the professionals equates to 589 years of experience, with an average of 21 years and 9 months experience per professional as provided in table 2.

Table 2: Mean and Combined Experience of Professional

Descriptive Statistics

	N	Minimum	Maximum	Sum	Mean	Std. Deviation
Year Service	27	1,00	41,00	588,50	21,7963	10,18696

Respondents were asked to indicate the sector that they were predominantly involved in, represented below. The predominant sectorial experience of respondents included commercial, civil infrastructure, residential and mixed use as well as to a lesser extent industrial and other. This sectoral experience is reflected in figure 3. The respondents had evenly spread experience in commercial, civil infrastructure, residential and all sectors.

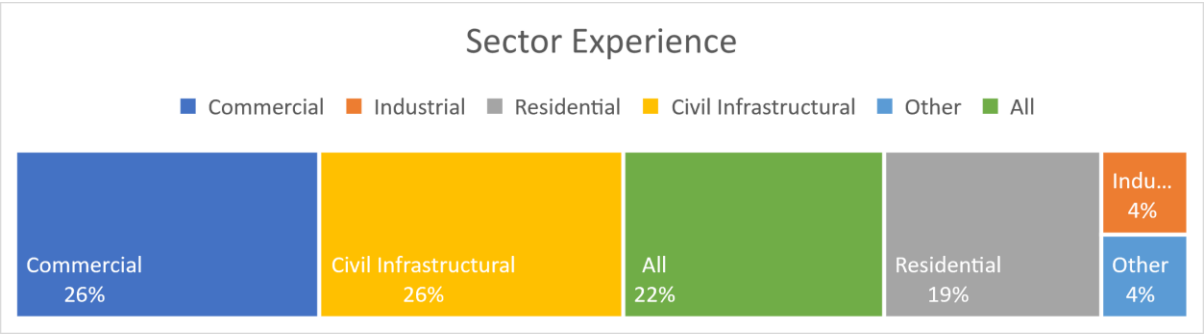

Figure 3: Sector Experience of Respondents

4.2 Quantitative Findings - Barriers

A test of reliability of the barriers two sustainable construction scale was performed to explore the internal consistency of the scale from the questionnaire. According to the results the barriers to sustainable construction scale has good internal consistency, with a Cronbach Alpha coefficient reported of 0.961. This means that the selected scale is reliable as it has a value greater than 0.7 (Pallant, 2013).

The quantitative results reveal that the highest barrier to sustainable construction in the real estate value chain is the higher perceived construction costs and green material costs, as reflected in figure 4. This is consistent with Vyas and Jha (2017) and Liyin Shen, Zhang, and Long (2017) but inconsistent with the findings of the Green Building Council South Africa, the Association of South African Quantity Surveyors and the University of South Africa that concludes:

> "The total average green cost premium over and above the cost of non-green buildings is 3,9 % for the cumulative period 2009 – 2018 compared with 5,2 % for the previous period 2009 – 2014. This is supported by a positive reduction in the average green cost premium to 3,5 % for the period 2015 – 2018… The green cost premium appears to be progressively diminishing over time, largely as a result of a growing maturity in the green industry." (Green Building Council South Africa, Association of Quantity Surveyors, & University of Pretoria, 2019)

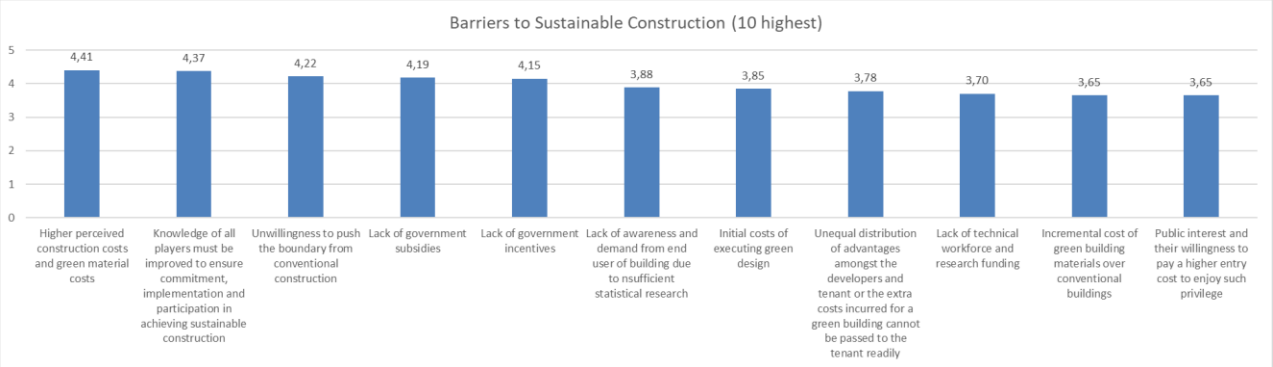

Figure 4: Top 10 Barriers to Sustainable Construction

The results also indicated that the knowledge of all players must be improved to ensure commitment, implementation and participation in achieving sustainable construction. This barrier needs due consideration as it was the next highest barrier that respondents indicated. Closely followed thereby was the unwillingness of participants in the real estate value chain to push the boundary from conventional construction. The fourth and fifth major barrier cited by participants was the lack of government subsidies and the lack of government incentives. The sixth highest barrier indicated by respondents is the lack of awareness and demand from end users of buildings due to insufficient

statistical research. Many respondents indicated that the initial cost of executing green design is a barrier to sustainable construction and is consistent with Hwang et al. (2017) argument related to "higher perceived construction costs and green material costs as well as incremental cost of green building materials over conventional buildings". In addition, the results of the survey cited the initial costs of executing green design as a barrier to sustainable construction. Participants signified that the unequal distribution of advantages amongst the developers and tenants with the extra cost incurred for the green building cannot be passed to the tenant readily was the eighth highest barrier. The lack of the technical workforce and research funding, and the incremental cost of green building materials over conventional buildings, as well as the lack of interest and their willingness to pay a higher entry cost to enjoy such privilege are the main barriers to sustainable construction.

Higher perceived construction costs

From the interviews conducted and the qualitative analysis, IN04 stated that in relation to the higher perceived construction costs "I think it has been…I think it's less or now … from the beginning that's been probably the biggest thing..." This was shared by IN03, "it's a perception as you say, it's not reality". IN04 argues "in fact some studies they found it's almost cheaper because you get a better building out of it " and further emphasized that a " 4 star building really shouldn't cost you anymore … whereas if you go for a 6-star, you've got to pay cost …you've got to put in most stuff there to hit your target of 6-star". IN06 submitted that "it's the mind of the designer, they think if you're designing something green it's much more difficult. It is not! It is a mindset you just change the way you do [things]." This view is shared by IN10 stating that the initial cost of executing green design is "actually a lot lower than a lot of people think … the common perception is around 20%, the reality is it is a lot closer to 5% and sometimes even less…[In addition], there is a cost of green building materials… there are cost associated with green buildings and green precincts". IN12 submitted that:

> "a lot of the resistances in terms of implementing sustainability comes from the property investor originally, in the sense that they argue that it is just not worth it… it is expensive, it increase[es] the development cost and the certification process is expensive and are not willing to pay for it and consequently it is not worth it… but the debate about a viability has moved on tremendously. It is way beyond what water and energy we need to be saving. So, sustainability kicked off with the 1% (i.e. utilities such as water and energy), that is where it started. Then it started to expand its vision. Then it said but what about the building itself... the latest research [by Harvard] indicates that's by far the most beneficial results, is the increase in productivity… The whole benefit of sustainable development has moved on from the energy and water saving to the actual total reduction in operating costs. The latest debate is about productivity… and the impacts of green buildings on cognitive functioning."

IN13 agreed that the higher perceived construction cost and green material costs was a strong barrier but that it did not related to the initial cost of executing green design and submitted that “a lot of the whole idea of green precincts, is in the precinct to keep things incremental. In other words, launch them when you need them” and thus lower the cost of construction.

IN14 opined that because the land developer is not the end developer and are basically “flipping” the land, “they don't see the benefit from the higher upfront costs, so in the long run [the end developer] wants to recover their money. Someone else [besides the land developer] will recover the money, so that can be a sort of issue. Furthermore, “where the industry is at the moment, it's very difficult to convince anyone to spend more up front”. In addition, IN14 submit that “it's very difficult with the public, not really wanting (the general public, the majority) not really wanting to go for these green star buildings. You are not guaranteed to get that higher rental, so I think it is risky.”

One major developer (IN12) argued that on the other hand from a perceived cost perspective, in the long run “buildings will be on the market at a certain rate per square meter” so “other companies that are not going to pursue this [green agenda] will be left with one alternative and that is to discount [in the future].” Furthermore, it is submitted the property developers are missing the point that either the premium is achieved up front for new development or the premium is achieved in terms of the increase in rental based on market annual properties, relative to the operating costs (that are reduced for sustainable properties) in the future. Thus, green buildings are both attractive now and into the future from a return on investment and cost perspective.

Lack of Incentives and Subsidies

IN16 submits that the main barrier is, “there is a lack of incentives from the developer's perspective because the land developer is just passing over life cycle cost to the tenant. The land developer wants to make his money, as much of it, up-front as possible, and don't pay the cost of the lifecycle portion of it. There is a lack of legislation… there's no incentive for him to be designing according to green building star ratings.” This is also submitted by IN14, and where the Council for Built Environment (CBE) has a major role to play, is to” legislate sustainable construction according to the Green Building Council requirements. For the [Land Developer] there's no incentive for him to design according to the green building star rating unless there is a market demand or policies or municipal by-laws requiring adhering to that … there is no real market driver at this stage in terms of policy”. IN16 submit that some of the other barriers not mentioned is for example the inability of local governments to set their own tariffs. This is a sentiment shared by IN03, as municipalities are unwilling to give approvals that compete with a future revenue streams, for example electricity revenue. IN16 argues that “on energy [municipalities] are constrained to use the Eskom tariff. If someone wants to put in a solar

panel [and] wanted to sell power at the Eskom [rate] less 20%, the municipality cannot take it because the municipality is bound to the Municipal Finance Management Act (MFMA) and therefore "cannot secure any contract longer than 3 years. For the solar project it will require some sort of sustainable contract of at least 10 years for the independent power producer (IPP)… to put down a plant because it's 10 to 20-year capital investment. Therefore, the municipality doesn't have the ability to enter into that level of agreement. It only given a 3-year mandate under the MFMA. So, they cannot procure sustainable independent sustainable power production and they cannot purchase it at rates less than Eskom, and Eskom has arranged a deal that prevents competition. That is until recently where the president has sought to remedy this in the recent budget speech. [This is because] now the municipality make strong profits from the sale of electricity to residents sold at discount rates and will not grant planning approvals unless the developer has lodged written proof of compliance with the conditions of establishment confirming that all internal and external services have been installed in the township to the satisfaction of the municipality" (eThekwini Municipality planning and Land Management By-Law, 2016). It is a massive barrier, and inhibiting legislation stopping it. IN16 submit that this has to change, and people are bucking the system anyway. The other issue is the technical issues and concerns in South Africa since "our networks were never designed with embedded generation as a concept. As soon as upgrades occur, our grid was designed as a radial supplier, rather than a radial receiver of power and becomes unstable. If electricity is pumped back, stability issues occur".

In support of IN16 proposition of changes needed, a recent article in Moneyweb on the 05th of September 2019 titled "Ekurhuleni Fast Forwards It's Green Energy Program" reads:

> "Projects that exceed 10 MW have to apply to the minister of energy via the Department of Energy… The awards are made subject to 3 conditions: 1) compliance with section 33 of the MFMA (contracts having future budgetary implications) to provide for a municipality to conclude contracts over periods longer than 3 years; 2) the conclusion of a power purchase agreement (PPA) between the IPP and the municipality; and 3) IPP obtaining the required generation license from the National Energy Regulator South Africa (NERSA). The capital investment [is] for the account of the IPP, but the [municipality] will sign a power purchase agreement that would guarantee that the off-take over a period of 20 years. With the PPA in hand the IPP can then apply for the necessary generation license. The municipality will only consider tariff equal to or less than the ESKOM megaflex tariff. The IPP's will be paid the full tariff for the first three years of the 20-year PPA, with discounts applied for the remainder of the period. the average discount rate for solar PV projects amounts to 8.7% and for natural gas technology 12.5% for example."

Section 33 for the MFMA requires that amongst others, where contracts have future budgetary implications beyond 3 year covered in the annual budget for the financial year, “the municipal manager must at least 60 days before the meeting of the Municipal Council at which the contract is approved, invite the local community and other interested persons to submit to the municipality comments or representations in respect to the proposed contract. The municipal manager also solicits the views and recommendations of the National Treasury and the relevant Provincial Treasury, the national department responsible for local government and if the contact involves water, sanitation, electricity, or any other service as may be prescribed, the responsible national department. The Municipal Council [will] take into account the municipalities projected financial obligations in terms of the proposed contract for each financial year covered by the contract, the impact of those financial obligations and the municipalities future municipal tariff and revenue. It is only after the Municipal Council has considered the impact of applications on the municipality’s future, will contracts longer than 3 years be approved. This is another significant barrier.

IN16 argues that “government policy has been a bit of an issue, it's a major obstruction. The documentation is there, the plans and the policies and the [strategic] roadmaps [are] there, just no one has picked it out and followed it… for example the Integrated Urban Development framework (IUDF)… it is done at a national level, but the linkage between provincial, national, and down to local governance [is not there]. I think the failing is at local governance.”

Conversely, the barriers to sustainable construction that was cited as least important to respondents was bad experiences with green building materials. Other barriers that were least important to respondents indicated that it is only large firms would have the ability to go beyond the minimum standard, the lack of green building project management framework, the professional low environmental and social awareness. In addition, the interdependency amongst construction stakeholders slow[ing] down the transformation towards sustainability, the lack of locally made green building materials, the hard to find materials or creating cutting edge designs, the increased transportation costs of green materials that are often imported, technical concerns were also considered as insignificant barriers. The incompatibility with other building components and the higher requirement for material handling in the construction stage was not found to be a barrier. These findings are represented in figure 5 below.

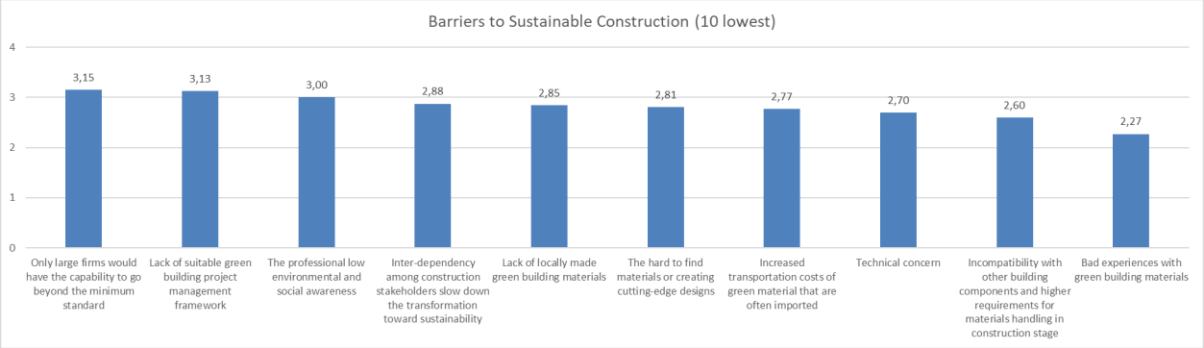

Figure 5: Lowest Percieved Barriers to Sustainable Construction

These results are surprising and reveal that green building materials are perceived to be readily available locally with relatively few bad experiences with green building materials. In addition, it indicates that green building materials are readily available locally and they're not seen to cost incrementally more. Furthermore, the results indicated that participants believed that it is not only large firms that have the capability to go beyond the minimum standards, but also medium and small firms are demonstrating the capability to go beyond minimum standards to a more sustainable future.

IN13 submits that:

> "a lot of the [green] materials are becoming the norm and that the increased transportation cost of green materials that is often imported is definitely not a barrier. In order to be green [on the precinct] side, you don't want to import. You want to use systems that are right here. From my experience, it is not a transport issue. You're defeating the point if you start bringing things in. It is time consuming, not hard to find materials or creating cutting edge designs. From a design point of view, the time-consuming side is to understand what is out there."

IN15 argues that the "interdependency and integrative sort of working together to come up with solutions" might speed up the transformation towards a sustainable industry, which is shared by other professionals for example IN10 and IN04.

IN15 argues that it is not only large firms that have the capacity to go beyond the minimum standards. "we are seeing much more interest from smaller organizations … and if we can show them that a few good initiatives could provide them with a good return, they'll be willing to increase from just the minimum standards."

The full list of barriers and the corresponding ranking is reflected in the descriptive statistics provided in table 3 below.

Table 3: Full List of Barriers to Sustainable Construction and the Corresponding Ranking

Descriptive Statistics

Barrier	N	Minimum	Maximum	Mean	Std. Deviation
Higher perceived construction costs and green material costs	27	2,00	5,00	4,4074	0,93064
Knowledge of all players must be improved to ensure commitment, implementation and participation in achieving sustainable construction	27	2,00	5,00	4,3704	0,83887
Unwillingness to push the boundary from conventional construction	27	2,00	5,00	4,2222	0,89156
Lack of government subsidies	27	1,00	5,00	4,1852	1,14479
Lack of government incentives	26	1,00	5,00	4,1538	1,15559
Lack of awareness and demand from end user of building due to insufficient statistical research	26	2,00	5,00	3,8846	0,95192
Initial costs of executing green design	27	1,00	5,00	3,8519	1,26198
Unequal distribution of advantages amongst the developers and tenant or the extra costs incurred for a green building cannot be passed to the tenant readily	23	1,00	5,00	3,7826	1,31275
Lack of technical workforce and research funding	27	1,00	5,00	3,7037	1,06752
Incremental cost of green building materials over conventional buildings	26	2,00	5,00	3,6538	1,01754
Public interest and their willingness to pay a higher entry cost to enjoy such privilege	26	1,00	5,00	3,6538	1,19808
Potential that green leases can also be hindered in their uptake if they disrupt or are burdensome to a tenant's primary operations, especially if tenants see little incentive to increase the sustainability of their landowner's property asset	25	1,00	5,00	3,6400	1,22066
Incentive provided by govt. often nullified by the prohibitive cost involved in certification	23	2,00	5,00	3,5217	1,08165
Relatively very few sustainable construction sites which were engaged in measuring energy flows and exchanges	25	1,00	5,00	3,5200	1,22882
Lack of environmental missions and strategies in real estate developer	27	2,00	5,00	3,4815	1,05139
Fragmented nature of the building supply chain and lack of knowledge between industry professionals about benefits of green procurement, sustainable construction and sustainable development	25	1,00	5,00	3,4400	1,00333
Lack of top management support for adopting green procurement	27	1,00	5,00	3,4074	1,24836
Developers in general ignore or even resist environmental initiatives	27	1,00	5,00	3,2593	1,31829
New technology requirements	25	1,00	5,00	3,2400	1,09087
Lack of enforcement and monitoring of law and legislation	25	1,00	5,00	3,2400	1,20000
High fabrication costs to meet crucial framework requirements	26	1,00	5,00	3,2308	1,10662
Technical difficulties during construction and unfamiliarity with green technologies	24	1,00	5,00	3,1667	1,04950
Only large firms would have the capability to go beyond the minimum standard	26	1,00	5,00	3,1538	1,40548
Lack of suitable green building project management framework	23	1,00	5,00	3,1304	1,25424
The professional low environmental and social awareness	27	1,00	5,00	3,0000	1,17670
Inter-dependency among construction stakeholders slow down the transformation toward sustainability	24	1,00	5,00	2,8750	1,26190
Lack of locally made green building materials	26	1,00	5,00	2,8462	1,08415
The hard to find materials or creating cutting-edge designs	26	1,00	5,00	2,8077	1,05903

Increased transportation costs of green material that are often imported	26	1,00	5,00	2,7692	1,45073
Technical concern	23	1,00	5,00	2,6957	1,14554
Incompatibility with other building components and higher requirements for materials handling in construction stage	25	1,00	5,00	2,6000	1,08012
Bad experiences with green building materials	26	1,00	5,00	2,2692	0,96157

The survey results and un-modified completed surveys can be discovered in Appendix D, as an example. The respondents' qualitative response of additional barriers to sustainable construction can be found summarized in the additional qualitative research findings as well as suggested further research.

The additional qualitative findings below were collected from the qualitative comments in the survey section (i.e. question 9 and 10), as well as the interviews held with subject matter experts in the field of sustainable development and construction. These findings are discussed in section 4.3 below.

4.3 Qualitative Findings - Barriers

One urban designer commented that:

> "…[W]e are very mindful of sustainable design and incorporate as much as we can upfront in the assessment and recommendations. We often embed these principles in the preparation of architectural manuals. The challenge is often in the implementation stage these principles are sometimes not effectively carried through due to client finances, cost of green building approaches and the eagerness to get the development underway. Often these get overlooked when the QS starts to crunch the numbers"

Other barriers not mentioned in the survey:

Other barriers not mentioned in the survey, which were gathered during the interview, include the lack of awareness and training, cost related matters, lack of integration of players up-front, and lack of interaction and connection of government, the developer, client and tenant, lack of government's capacity, and the general lack of government policies, incentives and subsidies.

The lack of awareness and training relating to sustainable construction was shared by IN11, IN04, IN09, IN14, and IN10. IN10 gave an example of continuity in the "green" chain of development that needed to be addressed through training and awareness (for example, separating refuse at source only to be dumped in one landfill or cycle lanes provided but no cycle parking is provided at the destination and vice a versa). The lack of knowledge of the general public and the municipality was highlighted by IN04. Skills in the construction sector and the level of innovation was submitted as additional barriers

to sustainable construction by IN10 and IN04 respectively. The lack of education related to sustainable construction was highlighted by IN04, IN09 and IN14.

The cost related barriers to sustainable construction was submitted by IN01, IN07, and IN15 as there is a CAPEX cost up-front, whereas the OPEX costs are incurred at the backend of development. There is the tendency for developers to externalize running costs in order to maximize profits and therefore "offload" indirect costs to the end user and therefore are unwilling to incur additional costs up-front. IN07 submitted that sustainable consultants are currently servicing the industry at a premium. Thus, there may be a need for a governing tool for the sustainability fee to govern the fee of sustainability consultant / green professionals as, unlike architectural fees and engineering fees that are regulated, sustainability consultant fees are currently not regulated. This however may be a driver for change towards sustainability in the future. IN08 submits, part of a gap lies and another thing that is driving these issues is the lack of financial capacity for small municipalities to simply provide a bulk main, and they don't have the capacity either to provide sewage trunk and into the sewage plant that is already struggling. So, it forces the property developer to become self-sufficient, however this triggers legislative requirements.

The lack of integration of players up-front, the lack of interaction and connection of government, the developer, the client and the tenant as well as the local government capacity issue is cited as common additional barriers that were not included in the survey sent to participants.

The overriding barrier highlighted by many participants in the qualitative analysis was the lack of government policies, incentives and subsidies at a precinct level as well as municipal support, for example IN13 submitted that environmental processes could take up to 2.5 years before land is shovel ready for construction. In addition, current norms and standards are not necessarily aligned with sustainable practices. IN05 argues that currently there is a lack of government policies to govern and manage the design, construct and monitor performance of sustainable interventions and currently we do not have an approved National Water and Sanitation Master Plan. The current plan is in draft form (i.e. NWRS2) and has not been approved yet. In addition, the carbon tax that has been promulgated (as well as the Health Promotion Levy) has not been used for sustainability initiatives nor linked with incentives. The will of both governments and developers is currently a barrier to sustainable construction.

IN12 opines that:

> "There are countries where the developer has no choice [but to develop sustainably], as 100% of electricity will be green because it originates from wind turbines or from other solar plants or a combination with hydro. [I]n South Africa [we have to] at huge cost put in PV panels [with] the challenge

> from a maintenance point of view, it is not giving us the percentage clean [energy] that we really want to achieve. The challenge is when we try to be innovative [and establish a solar farm] there is no chance of getting your electricity [during load shedding] from the solar farm to your property. Your property is also load shedding as well. How can we expect so many millions of generating electricity for ourselves and we don't have at least the guarantee that we will have 24/7 access to electricity?"

Besides indicating the current barriers to sustainable construction, participants were also requested to indicate the framework most commonly used by land conversion participants. These additional findings are provided below in section 4.4.

4.4 Additional research findings

Professionals involved in the land conversion real estate value chain most commonly use Infrastructure Sustainability as the infrastructure framework tool. This is an Australian infrastructure rating tool that is currently being utilized by the Green Building Council South Africa (GBCSA) as an input into the Sustainable Precincts rating tool that is currently being developed for South Africa. Other infrastructure frameworks that are being used by land conversion developers and professionals include One Planet Living (OPL) developed by Bioregional, the Red Book Human Settlement Planning And Design (volume 1 and 2) published by the CSIR Building and Construction Technology updated to the Green Book (Adapting Settlements For The Future) also developed by the CSIR as "an online tool [to] support municipal planning with the development of climate resilient settlements… facilitating the mainstreaming of climate change adaption into local government planning instruments and processes." Figure 6 below provides an indication of the infrastructure frameworks used by South African land conversion professionals to promote sustainable construction and sustainable development.

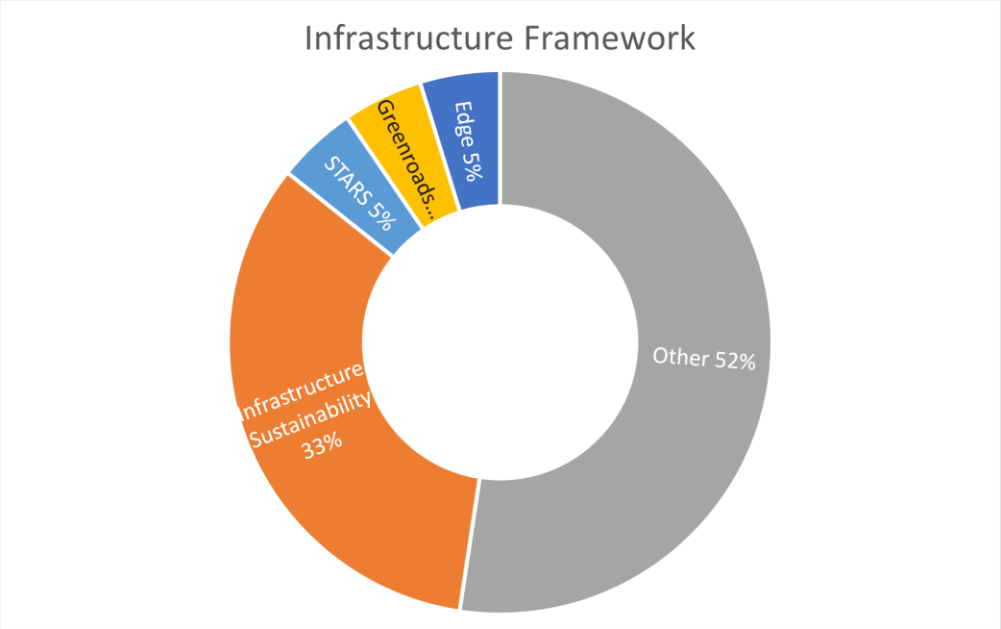

Figure 6: Infrastructure Framework

Interestingly were that not many participants were familiar with Greenroads which is being used by SANRAL to develop a system to measure and manage sustainability in transportation projects in South Africa. Greenroads is an international rating system. Equally surprising is that The UK and United States, CEEQUAL and Envision respectively, rating tools are not used to a great extent in South Africa at a precinct level or infrastructure level. The full results of the survey are presented in table 4 below and indicate that infrastructure sustainability is the most commonly used framework.

Table 4: Full List of Infrastructural Framework Influence

Descriptive Statistics

Infrastructural Framework Influence	N	Minimum	Maximum	Mean	Std. Deviation
Infrastructure Sustainability	17	1,00	5,00	3,7647	1,20049
Greenroads	10	2,00	5,00	3,5000	0,84984
GreenLITES	7	1,00	4,00	2,8571	1,06904
Hydropower Sustainability	8	1,00	5,00	2,7500	1,16496
INVEST	8	1,00	4,00	2,7500	0,88641
EDGE	11	1,00	4,00	2,6364	1,02691
BCA	8	1,00	4,00	2,6250	1,30247
CEEQUAL	8	1,00	4,00	2,6250	0,91613
STARS	8	1,00	4,00	2,6250	0,91613
ENVISION3	7	1,00	3,00	2,2857	0,75593

Qualitative Findings

IN02 stated "in my experience there has been no focus on specific frameworks relating to infrastructure. The focus [has] been more on buildings." This is a sentiment shared by the GBCSA and many participants but is being addressed at a precinct level through the Sustainable Precinct rating tool that is in the development phase by the GBCSA.

In respect of building rating systems, the dominant rating system used in South Africa is the Green Star which has been developed by the Green Building Council of South Africa (GBCSA) that is based on Green Star (AU). According to IN04 the reason for this was that the Green Building Council of Australia was the only organization that would allow their rating tool to be customized for South African conditions and is the only rating system promoted by the Green Building Council South Africa. The MSCI Green Building Index is an index developed mainly for JSE listed properties to compare conventional building returns with green buildings returns and is not particularly used at a precinct level. Other rating systems used when international investors are involved include LEED and BREEAM. The results of the most commonly used building framework are presented in figure 7 below.

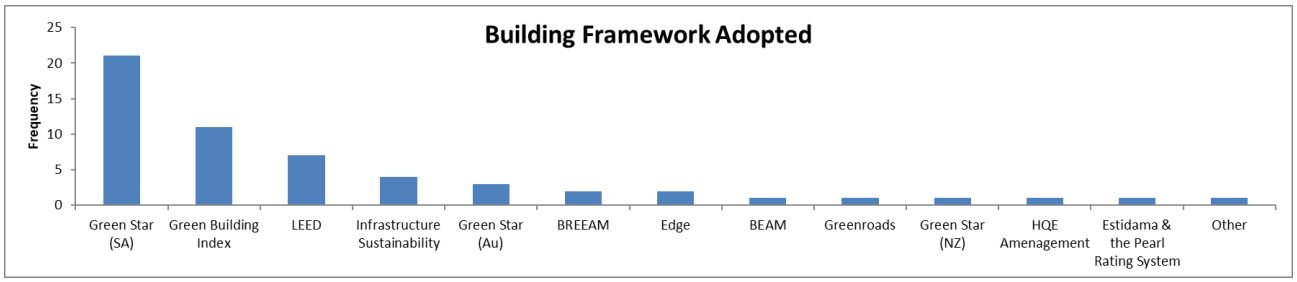

Figure 7: Building Framework Adopted

Respondents had mixed reaction to the influence of various rating systems on sustainable construction in South Africa, however the main framework that influenced sustainability from a building perspective were Green Star (SA) by quite a long way, followed by LEED, Green Building Index, Green Star (AU), and EDGE. The full list of results of the influence of the various building rating systems is provided in table 5 below.

Table 5: Full List of Building Framework Influence

Descriptive Statistics

Building Framework Influence	N	Minimum	Maximum	Mean	Std. Deviation
Green Star (SA)	20	3,00	5,00	4,2500	0,85070
LEED	12	1,00	5,00	3,3333	1,37069
Green Building Index	12	1,00	5,00	3,1667	1,26730
Green Star (Au)	7	1,00	5,00	3,1429	1,34519
Edge	10	1,00	4,00	3,0000	0,94281
Infrastructure Sustainability	9	1,00	5,00	3,0000	1,65831
Greenroads	8	1,00	5,00	2,7500	1,58114
BREEAM	7	1,00	4,00	2,5714	1,13389
Green Globes	7	1,00	5,00	2,5714	1,27242
Green Star (NZ)	8	1,00	4,00	2,2500	1,28174
SBTool	6	1,00	5,00	2,1667	1,60208
CEEQUAL	7	1,00	4,00	2,1429	1,21499
Greenship	7	1,00	4,00	2,1429	1,21499
GreenLITE	6	1,00	3,00	2,0000	1,09545
HQE Amenagement	6	1,00	4,00	2,0000	1,26491
BCA Green Mark	6	1,00	3,00	1,8333	0,98319
Envision3TM	6	1,00	3,00	1,8333	0,98319
CalGreen	6	1,00	3,00	1,8333	0,98319
INVEST	6	1,00	3,00	1,8333	0,98319
BEAM	6	1,00	3,00	1,6667	0,81650
BERDE	6	1,00	3,00	1,6667	0,81650
GRIHA	6	1,00	3,00	1,6667	0,81650
Estidama & the Pearl Rating System	7	1,00	3,00	1,5714	0,78680
CASBEE	6	1,00	3,00	1,5000	0,83666
China Ministry of Construction green Building System	6	1,00	3,00	1,5000	0,83666
DGNB - the German Sustainable Building Certificate	6	1,00	3,00	1,5000	0,83666
STARS	6	1,00	3,00	1,5000	0,83666
NABERS	6	1,00	3,00	1,3333	0,81650
NatHERS	6	1,00	3,00	1,3333	0,81650

Other infrastructural sustainability frameworks used include, the CSIR Green Book, GBCSA Sustainable Precincts, and the municipal policies such as Sustainable Drainage Systems (SuDS).

Having identifies the frameworks and barriers to sustainable construction respondents provided insights and thoughts of the next steps and useful strategies that could be employed by land conversion participants to overcome the barriers to sustainable construction in the real estate value chain. These strategies are described in section 4.5 below.

4.5 Strategies that can be employed to promote sustainable construction and overcome the barriers in the real estate value chain

IN12 submits that:

> "what is important in respect of new developments is facilitating the interaction between the developer and the professional and sort of… challenges right up front. This is what sustainability is all about… what happens with the green building from a developer's perspective, you have to facilitate the process between the professionals to say that those days [of working in silos] are gone. You cannot design what you want to. You have to listen to the sustainability consultant, you have to listen to the facade engineer, you have to listen to the mechanical engineer, you have to listen to the structural engineer and the sustainability consultant needs to listen to the quantity surveyor (QS). [The QS] has to listen to the other professionals, because the best development is the one where you get that balance, that harmony between the professionals where they start to understand how their disciplines interact and dovetail with the other disciplines and they get what is best for their discipline but also within the design and costs for the other disciplines."

IN13 submits that we have to de-engineer the engineers. IN12 argues that "[a] lot of countries… seriously embrace sustainability and what they do… in the green building conference where the following happens. The appropriate minister would be the opening speaker and would say something like 'this company has set the following commitments by that date'… that is what you [got to] do! The next speaker is the mayor of the city and the mayor says cascading it down, this is what he's going to do. He is going to do his proportional contribution to achieve the government total commitments for that node and everyone is focusing and really excited and working on this common objective to make the city [sustainable]. It starts from the buildings, then it's the precincts and then it's the cities and then it's the region and then it's the country, [and then it's the global]… The importance of this, is if [the] government is committed to sustainability it makes it so much easier for development."

IN14 argues that sustainability is not something that's pushed from an [engineering] training perspective … during undergraduate degrees. [Sustainability] is talked about but there is no practical. IN14 argues that universities and higher education "is the framework for driving [sustainability] as well as during professional registration". Currently, "it's touched upon but there's nothing [that says] "you must do this". There is no policy in place that says, "you must do this". I think that the awareness is not there, and the actual knowledge of what can and can't be done is not there. If the professionals don't know all this stuff, how can you expect the people that are advising the real estate developer to say yes or no, so I think there is a shortfall there from an educational perspective. IN14 argues

> "raising awareness is the key strategy to overcome barriers to sustainable construction. People don't know what they don't know, the more you get people, the right people aware about it, the quicker I

> think the barriers will start to fall through voluntary associations from a professional point of view. You have workshops at events with professionals where experts come and speak about sustainable construction and sustainable precincts and what it is, as well as giving examples of what has been done so that engineers can go out and research it themselves. It is all about just getting it out there more."

So, this can be done through South African Institution of Civil Engineering (SAICE) (a voluntary Association) but more importantly through the Engineering Council of South Africa (ECSA) which is the actual governing body that brings in the Acts and the Government Gazettes and controls professional registration in the built environment and reports to the Council for Built Environment (CBE). IN14 argues that the "quickest way to get private developers on board is to show them a way in which to make money from it and they will get on board. Also, there is the need to dispel the misunderstanding that we have to be 5-star rated. This is not necessary. If it is well known that the four-star rating is pretty much the same cost but the return on investment is that much higher, if you can show this with solid case studies to developers," this will demonstrate to developers that they can make money doing this. IN15 submits that "if we can go to the developers and show them each credit that we target and the return on investment, then their perception might change, definitely."

IN15 argues that "in South Africa [the attitude] is many years behind other countries. Our developer's or doing it because it's a marketing tool or it's a tick the box sort of thing", whereas in places like Australia "the government is pushing them, it is all about climate change mitigation and global warming … We need a much bigger stick in South Africa."

IN16 argues that because of the lack of legislation and market demand or policies or municipal by-laws requiring adherence to sustainable construction, and municipal by-laws need to change, for example, it should be a legislated requirement that in order to get a handover certificate, Green Building Council star rating requirements must be complied with and the city architectural department should be taking the lead in this as to what they will accept and what they won't accept. The other issue is just to educate the populace about the lifetime escalating cost of energy at 13% per annum. In addition, IN16 submits that instead of digging coal out of the ground that maybe secure short-term jobs, there is an entire green economy that could be developing in parallel, if South Africa invest in it. It would obviously require a higher level of technical skills to sustain that level of employment, but there is a whole new economy that could, theoretically, be developing in the background and the same would apply to water.

IN16 submits that

> "there's a lack of awareness amongst all sectors of society about what sustainability really means … there is a cultural issue that needs to be addressed through education and it should start with our

> children, through the education system. We are in trouble already, we're already passed the barriers of the biosphere… We on the hiding second to nothing, as a global entity, until we do things differently and it is difficult because countries are trying to elevate themselves out of poverty and they are doing it on the back of economic development which requires energy."

IN04 submits that, additional strategies that should be employed to address the awareness and training barrier identified include, better education of the public, professionals, tenants, end-users [and] all players in the market in the real estate value chain of climate change and resource depletion and the link to building and the interrelationship with buildings and infrastructure. Educating the public about the annual increase in energy cost and the lifetime escalating costs of energy at approximately 13% per annum currently and the imminent global crisis would partially address the barriers identified.

IN14 argues that the awareness, education and training barriers can be addressed by getting the right people aware of sustainability, from university / tertiary level, through organizations like the Council for Built Environment (CBE) (that have legislative powers), voluntary associations such as South African Institute of Civil Engineers (SAICE), knowledge and awareness can be increased by organizations such as Green Building Council of South Africa (GBCSA), the South African Property Owners Association (SAPOA), publications and reports such as the Rands and Sense of Green Buildings by the GBCSA made available to developers and other role players since currently there is not enough information available, not enough road shows and reports are expensive to acquire. There are currently insufficient voluntary events where sustainability and sustainable construction is promoted, and consequently insufficient research performed by practicing professionals. IN14 suggested that the most effective method of raising awareness of sustainability and sustainable construction is to "give credit to groups of people where credit is due since people drive sustainability, not processes, rules and frameworks." In addition, "strong, continuous marketing of all sustainable projects, in particular those that are high profile and/or iconic with which people identify and like to be associated with, are likely strategies to raise awareness of sustainability."

IN10 submits that in order for strategies to address the perceive cost barriers and the initial cost of executing green design barriers as well as the perceived incremental cost of green building materials over conventional buildings, there needs to be a greater awareness of the cost and benefits of sustainable buildings and precincts. IN12 submits that, and it links with the greater incentives required by government, there should be a greater Public Private Partnership (PPP) where government or the municipality "facilitate and pass the pro forma documents" to allow "either the owner or the investor in the green infrastructure to put their money down to get that building [or precinct] sustainable or green. The savings achieved from the green infrastructure is first allocated to the investor who

requires an acceptable (say 12%) return. The balance of the saving is split between the tenant, and the owner. The owner gets a green better building and the tenant gets the saving in energy and water. A win-win situation. The municipality also benefits from the smarter cities in that it is able to attract top talent that can work anywhere in the world. Sustainable construction starts with the building, then the precincts, then the regions and then strategy for the entire country. Other strategies to promote sustainable construction could be in the forms of income that municipalities could for example generate, is from urine income which could be used to fund incentives and subsidies. If urine is separated at source, it becomes a lot easier to convert this into fertilizer using the natural anaerobic process from feed from the sewerage and organics. IN13 submits this "quiet inert anaerobic process is generating heat naturally by organisms working". At temperatures above 32 degrees Celsius the urine takes just "30 days to get all the pathogens and process to a point where you can actually use it as fertilizer, instead of the usual 6 months. This additional income from urine is just one of the many additional forms of income that the municipality could use to promote sustainable construction and promote the circular economy.

Additional strategies that should be employed to overcome barriers, as submitted by IN04, include the integration of players up-front, in the sense that designs at the beginning should cater for sustainable construction. The design up-front should integrate the different parts of the team. In addition, the interaction and connection with government, the developer, client and the tenant should be demonstrated in that government needs to consult the industry players in formulating appropriate and usable policies.

Various policies should be formulated and/or updated to enable sustainable construction in the real estate value chain such as:

- there should be pre-requirements for green initiatives to be included in building plans before design and construction is approved (IN06).
- by-laws need to change, such that it is a municipal by-law that in order to obtain a handover certificates the developer has to have designed and constructed according to the Sustainable Precincts Rating tool at the precinct and infrastructural level and according to the Green Star rating at the building level. Such by-laws will create the market demand and policy necessary to promote sustainable construction.
- changes to the MFMA Act that currently places onerous conditions on sustainability initiatives such as solar energy production which is a 10 to 20-year capital investment. Currently the municipality will only consider power purchase agreements (PPA) at the tariff equal to or less than the ESKOM mega flex tariff. The additional legislation is onerous and cumbersome, as

described earlier under the heading higher perceived cost, as municipal approvals will only be granted after consideration of the impact of the proposed contract on the future municipal tariff and revenue.

- policies need to be driven by local government (IN16) and should consider considerations such as the watershed which should be written into the required legislation to promote sustainable construction (IN05). There needs to be a growing commitment by government to sustainable construction and net-zero development (IN05).
- The establishment of an Independent Water Regulator that is answerable to parliament, and not to any ministry, is required to regulate the water sector is necessary to promote sustainable construction, that "makes impartial regulation of the construction and real estate sector, for example when providing water and sanitation to government, contracting with bankrupt municipality is an issue. There are current initiatives by both the government through the Public Private Growth Initiative (PPGI) as well as the establishment of the Water Chamber to coordinate private investment into the water sector. This will synchronize the construction sector with the water sector and municipality, as currently the focus is on energy and renewable energy. Renewable water also needs to be added on, since the next crisis will be water, "not only volumetric… but also quality" because currently we are polluting our water. IN08 submits that "the establishment of the Water Chamber, the Independent Water Regulator that is answerable to parliament [is required]… The South African Water Chamber [will] represent the private water sector right from financing through to construction, capacity building, institutional building… as a vehicle or platform to lubricate the transaction between the private and public sector in the provision of water and sanitation… [where] the Green Building Council will be invited to participate as stakeholders]… the government may not have the capacity to stimulate the infrastructure segment and so needs private sector funding, and co-funding from the private sector.
- other policy issues that need to be resolved are initiatives and policies that promote investments in local businesses to create sustainable materials and promote sustainable precincts that include smart grids, district cooling, water conservation, urban farming, and ecosystems that are environmentally friendly and pedestrian friendly.

In addition to the above policies, other strategies required to overcome the sustainable construction barriers are greater incentives from government (both local and provincial) as well as municipal incentives and schemes for developer's and policies to promote sustainable construction, for example:

- council concessions on rates and qualifying expenditure (IN05)

- rates reduction and better tariffs for electricity that is sold back to the grid (IN09) and green off-set schemes (IN05)
- planning concessions and density bonuses
- prioritizing approval of plans with green initiatives and mixed-use precincts

Greater government by-in and the need for stronger legislation and subsidies are required to overcome the barriers to sustainable construction. The subsidies could be for the, and through the establishment of, non-profit organizations (NPO) for the gathering of data related to social, economic and environmental needs of the community in the area of the proposed development including training requirements and the establishment of socio-economic sustainability and innovation programs in the design phase. This would be to sensitize the community of opportunities in the provision of bulk infrastructure, broad walks, supplies of material and community involvement during the construction and post construction during operations and the management phase.

4.6 Research Finding Discussion

The finding of the research support research conducted by Dwaikat and Ali (2018), that there is a lack of building owners' interest in the future costs and benefits of green buildings. In contrast, the GBCSA (in association with ASAQS and PU), (2019) has found that the green premium associated with sustainability has diminished progressively since 2009 to 2018 and thus contrary to the results of the research. It indicates that it has more to do with the perception of professionals and those involved in the real estate value chain that sustainable construction costs more. These perceptions need to be changed and informed by more education and awareness about the benefits and cost advantages of sustainable construction, which respondents agreed needs to be enhanced to make sustainable construction at the forefront of decision making. The respondents generally agree that there is the lack of education and awareness about green building benefits.

The findings of Lorenz and Lutzkendorf (2008) that there is a lack of experience and available data is not supporting by the respondent in this research performed recently. In contrast, respondent believed that the experience of professional involved in green construction and data is available. This could be explained by the significant progress is the area of green building and sustainability since 2008 to 2018, that the GBCSA et al. (2019) described, and the fact that Lorenz and Lutzkendorf performed their research in 2008. It does give support to the fact that greater focus and attention is being paid in the area over the last decade and that there has been progress in the area of experience and availability of data to support sustainable construction.

Hwang et al. (2017) submission that there were sites engaged in measuring energy flows and exchanges was not well supported by the empirical evidence gathered in the research, as this barrier

was not cited by many of the respondents. The shortcoming of this finding may be explained by the limited number of respondents and the limited available pool of experts in the land conversion process who may not necessarily be directly involved in the building construction but rather considered the energy flow at a precinct level.

In addition, the literature seems to suggest that green building materials are expensive since they tend to be imported however this assertion is not supported by the findings of the research of this paper. In fact, many research participants indicated that green building materials were available locally. This is a positive sentiment, as it indicates that materials are available locally and that in order to go green it does not necessarily mean importing, as this would defeat the aim of sustainable construction that aims to consider the local social, environmental and economic impact of construction and related activities.

Abidin's (2010) argument that the interdependency of construction stakeholders will slow down the transformation towards a sustainable industry was not well supported by the research participants who contend that the interdependency among stakeholders would speed up the process of transformation as leaders in this area would encourage and pull others to follow suite. It is the integrative thinking, in coming together with solutions that will speed up the transformation to a sustainable industry. Such findings are positive as it provides good reference points for participants in the real estate value chain to embrace sustainable construction and the leading of other participants to a more sustainable future for all. It is the collaborative transformation that will lead to sustainable construction going forward.

The research findings greatly support many authors contention in the literature that the initial perceived high cost of sustainable construction and materials was a significant barrier to sustainable construction and agree with Liyin et al. (2017) that the additional premium is often exaggerated. In fact, many participants agreed that the cost of green and sustainable construction was only marginally higher than conventional construction, but it is the perception and exaggeration of higher cost that needs attention and focus in order to journey and move toward to a sustainable future. It is only when participants are presented with factual and well researched findings that this false perception will be overcome.

The authors, Shen et al. (2017) and Abidin (2010) submission in the literature that government subsidies and incentives for sustainable construction was scarce, is supported by the empirical evidence gathered. It is the government subsidies and incentives that are lacking to support the transformation to sustainable construction. At the moment, there is insufficient "carrots", which is

compounded by insufficient laws and “stick” enforcement, to entice participant in the real estate value to transform to sustainable construction and practices.

Hakkinen and Belloni (2011) argument of a lack of knowledge, skills and lack of exposure to sustainable construction is supported by the research findings in the research paper. By addressing this lack of knowledge, skill and lack of exposure to sustainable construction in the real world, the real estate value chain can be transformed and journey to a more sustainable future. In addition, the gap in younger generation between higher education and the lack of experience, to convert theoretical knowledge into practice, in the real world is confirmed in the quantitative findings. Thus, there is a great need for practitioners and real estate participant is the business environment to be quick to listen to the ideals of the younger generation yet to harness these ideals to ensure that these ideals produce the outcomes desired in a practical and sustainable manner.

Abidin’s (2010) contention that only large firms have the capacity to go beyond the minimum standards and are willing to adopt sustainable practices is refuted by the research findings which ranked this as a relatively low barrier to sustainable construction since it is suggested that small and medium firms are also willing to adopt sustainable construction but the demand from end users has not prompted these firms to transform. It demonstrates that the will of smaller and medium firms is there, but what seems to be lacking is the demand from the end-user for sustainable building and infrastructure. Without the demand from the end-user the transformation to sustainable construction will be slow. The recent study by Harvard titled ‘The impacts of green buildings on cognitive function’ demonstrates that the greatest benefit of sustainable building is on increase productivity. Thus, as end-users are educated and enlightened about the benefits of sustainable construction on cognitive thinking, the greater the demand will be from the end-user for sustainable environments which in turn will spur other participant in the real estate value chain to a more sustainable future.

It was further discovered that, there is little evidence to support Shen et al. (2017) opinion that the application of sustainable construction is hampered by the developer’s bad experience with green building materials. The research did not reveal that participant in the real estate value chain had experienced bad experience with green building materials and thus this was not seen as a major barrier to sustainable construction.

Other findings that our contrary to the literature related to the environmental and social awareness of professionals which some authors argue are lacking. This was found not to be the case. Through the interviews it was clear that participants were acutely aware of the environmental, economic and social impact of construction activities and the need for sustainable construction. This is positive to

note, as it highlights that professionals are increasingly aware of environmental and social aspects, but as mentioned earlier what may be lacking is more about the end-user demand.

The research findings support Abidin's (2010) opinion, and other authors, that the knowledge of all players must be improved to ensure sustainable construction is achieved. The results also indicate that the knowledge of all players must be improved to ensure commitment, implementation and participation in achieving sustainable construction. These factors and barriers clearly point to the need for greater awareness and education amongst all players in the real estate value chain, as mention earlier.

4.5 Research Summary

The research concluded that there is a higher perceived construction and green material costs amongst real estate participants, it is a perception rather than a fact. More needs to be done to raise awareness and education of the diminishing green cost premium and the benefits of sustainable construction to address the false perceptions about sustainable and green construction costs. This awareness and education will also address the next highest barrier, that being, to improve the knowledge of all players to ensure, implement and participation in the achievement of sustainable construction. In addition, participants in the real estate value chain need to be willing to shift the boundary from conventional construction to alternatives to traditional construction.

The research also concluded that there is generally a lack of government incentives and subsidies to promote sustainable construction. These incentives and subsidies are needed to shift the real estate value chain into the sustainable construction path and into the mainstream of strategy development and decision making.

The end-user demand has a significant impact of whether sustainable construction is pursued, without such demand the transformation to sustainable construction will be slow. The research finding concluded that, in general, there is a lack of awareness and demand from end user of the building due to insufficient statistical research.

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

This chapter summarises the research finding and brings the research to a close. It also sets out the limitations of the research findings and makes recommendations for additional research.

Research background and approach

The research commenced with the research problem to address, that construction activities have significant impacts on the economy, community and the environment and the proposition that few organisations in South Africa adopt sustainable construction in the real estate value chain. The premise was that rarely do role players bring integrated sustainable construction into the decision making and business practices. For many developers, environmental and social aspects are not a priority. Addressing this issue can provide legislators, policy makers, urban planners, entrepreneurs and industry captains with references for urban sustainability. The research results provide important reference points to assist developers, owners, consultants and government departments to take actions towards mitigating sustainable construction barriers in the real estate value chain and thus promote a more sustainable development future. To address the proposition the research established what level of knowledge and understanding do land conversion professionals, developers and end-users have concerning the concept of sustainability, sustainable development and sustainable construction as well as what the barriers and constraints of sustainable construction (i.e. a land conversion perspective in the land conversion sector of the real estate value chain).

The aim of this research was to establish the foundation necessary for sustainable construction in the real estate value chain and examines the gap and barriers between knowledge and implementation.

The research for this paper satisfied the proposition that, the barriers and constraints of sustainable construction, in the land conversion process of the real estate value chain can be identified. The research objectives were to answer the research question posed. The research objectives were:

- Understand the literature pertaining to real estate value chain (differentiating between land conversion, building construction and ongoing operations thereafter), sustainable construction, sustainable buildings and the barriers to sustainable construction as well as understanding sustainable construction.
- Understand the term sustainable construction and what level of knowledge and understanding do developers and participants have concerning the concept of sustainability, sustainable development and sustainable construction?
- Identify and analyse the barriers and constraints to sustainable construction and how it effects the land conversion process of the real estate value chain.

The research objectives have been achieved and the research question answered.

Research findings

The research aimed to answer the following question: What are the barriers and constraints of sustainable construction in the land conversion process of the real estate value chain?

The research has revealed that the main barriers to sustainable construction from a land conversion perceptive relates to the perceived cost of green buildings and design and lack of awareness and education as to the benefits of sustainable construction. These barriers are linked and can be overcome by raising the awareness an education of participants in the real estate value chain. Such awareness and education should highlight the diminishing premium of green buildings over conventional buildings over the last decade as well as the lifecycle benefits of sustainable construction and green precincts. The awareness, education and training barriers can be addressed by getting the right people aware of sustainability, from university / tertiary level, through organizations like the Council for Built Environment (CBE) (that have legislative powers), voluntary associations such as South African Institute of Civil Engineers (SAICE), knowledge and awareness can be increased by organizations such as Green Building Council of South Africa (GBCSA), the South African Property Owners Association (SAPOA), publications and reports such as the Rands and Sense of Green Buildings by the GBCSA et al. (2019) made available to developers and other role players since currently there is not enough information available, not enough road shows and reports are expensive to acquire. There are currently insufficient voluntary events where sustainability and sustainable construction is promoted, and consequently insufficient research performed by practicing professionals. Research participants suggested that the most effective method of raising awareness of sustainability and sustainable construction is to “give credit to groups of people where credit is due since people drive sustainability, not processes, rules and frameworks”. In addition, “strong, continuous marketing of all sustainable projects, in particular those that are high profile and/or iconic with which people identify and like to be associated with”, are likely strategies to raise awareness of sustainability.

The unwillingness to push boundaries from conventional construction and the lack of government subsidies and incentives are also major barriers to sustainable construction in the land conversion planning and development activities. These barriers and constraints have been identified through the analysis of the surveys and as a result of the interviews conducted with experts in the field of sustainability and land conversion activities. To overcome these barriers the following 3 main strategies and interventions are required:

a) Greater awareness and training for all participant in the real estate value chain of the benefits of sustainable construction to improve the knowledge of all players to ensure commitment, implementation and participation in achieving sustainable construction.
b) Greater government incentives and subsidies that are distributed evenly throughout the real estate value chain.
c) A further reduction in the incremental cost of green building materials over conventional buildings

Additional finding from the research revealed that the main rating system used to promote sustainable infrastructure construction is Infrastructure Sustainability (IS) and Sustainable Precincts whereas from a building design and construction perspective, the main rating system used is the Green Star (SA) rating system with limited influence from LEED, Green Star (AU) and EDGE. The MSCI Building Index is used by listed property funds to demonstrate the economic benefit of green building as compared to conventional buildings. From a land conversion perspective many of the participants adopt sustainable construction and bring integrated sustainable construction into the decision making and business practices however more can be done to make it a priority.

Research limitations

The limitations of the research are that the survey was conducted using a sample of professionals that are involved in land conversion activities. This reduces the potential sample size in that this is a niche market with few professionals that have experience in this area. Challenges were experience in accessing professionals who rather preferred being interviewed instead of online surveys. The time limit to collect responses in this manner may have reduced the ability to collect more responses as well as the time required to transcribe and qualitatively analyze the rich text.

Further limitations include that access to senior land conversion participants was limited and in most instances 2 participants (at most) from each professional firm were able to afford time for the interview due to competing demands in the industry for their time and attention. This may have an impact of the ability to generalize the finding to the rest of the land conversion participants.

In addition, the sample selected did not include legislators and municipality participants and thus may lack a deeper perspective of participants in the real estate value chain and may be a unit of analysis for further research.

Beyond this research

With further research and study these findings could be used to formulate suggestions to overcome the major barriers and promote sustainable construction. With further attention, strategies to

mitigate the significant barriers could be developed, including green procurement promotion (Liyin Shen, Zhang, & Long, 2017).

To account for the various limitations above, it is recommended that sample size is increased with more direct interviews conducted with land conversion professionals, developers, end-users, legislators and municipal participants to determine what key strategies land conversion participants develop to ensure that sustainable construction is applied throughout the real estate value chain?

To answer this, the following precedent questions need to be answered:

1. What are the key drivers of sustainable construction?
2. What incentives for sustainable construction are offered to ensure that sustainable construction is applied throughout the real estate value chain? What measures are applied to ensure that incentives are equally shared between project participants to improve the coordination of participants towards a sustainable future?
3. What measures are specified in projects to ensure that sustainable construction practices are adopted by real estate players in the real state value chain? What construction project participant collaboration framework is commonly used to enhance communication with project participants in order to promote sustainable construction in the real estate value chain;
4. Risk and return of sustainable construction on exit. Further research is required on the effect of sustainable construction on the exit strategy of the various actors? Does sustainable construction improve the property values of erf within a precinct?

There is further investigation merited to understand the barriers and constraints to sustainable construction in the real estate value chain, to ensure a more sustainable industry.

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APPENDICES

APPENDIX A: Survey Research Questionnaire

Background:

Question 1- Please indicate your primary business occupation. Please select only one option:

Architect	☐	Engineering - Civil	☐	Hospitality, Travel and Tourism	☐
Auditor	☐	Engineering - Electrical	☐	Landscape Architect	☐
Construction Manager	☐	Engineering - Mechanical	☐	Manufacturing	☐
Developer / Owner	☐	Engineering - Pavement	☐	Quantity Surveyor	☐
Financial Services	☐	Engineering - Traffic	☐	Medical Industry	☐
Government Dept.	☐	Engineering - Structural	☐	Town Planning	☐
Green Building Council	☐	Environmental Sustainability	☐	Urban Design	☐
Project Manager	☐	Development Manager	☐	Principle Agent	☐
Consulting Engineer	☐	Health and Safety	☐	Client / Employer	☐
Media	☐	Research Consultant	☐	Economist	☐

Source: https://www.edgebuildings.com/edge-experts/online-training/

Question 2 - How long have you been working in the field of real estate? Number of years

____ years

Question 3 - Which sector of the real estate do you predominantly service?

Retail	☐	Hospitality	☐	Educational	☐
Commercial	☐	Offices	☐	Other	☐
Industrial	☐	Residential	☐	All	☐
Government	☐	Civil Infrastructural	☐		

Source: https://www.edgebuildings.com/edge-experts/online-training/

Study

Question 4 : What framework is most commonly used by land conversion professionals to determine <u>infrastructural</u> sustainable development goals in land conversion planning and development activities? (International Federation of Consulting Engineers, 2019)

BCA Green Mark	☐	Edge	☐	INVEST	☐
CEEQUAL	☐	GreenLITES	☐	STARS	☐
Envision3™	☐	Greenroads	☐	Other	☐
Other	☐	Infrastructure Sustainability	☐		

Other Frameworks:_____

Source: http://fidic.org/node/5943

Question 5: To what extent to do you perceive the following frameworks affect <u>infrastructural</u> sustainability planning and construction?

	Strength of Influence					
	Not at all	**Little**	**Somewhat**	**Quite a bit**	**To a great extent**	**No Opinion**
BCA Green Mark	1	2	3	4	5	6
CEEQUAL	1	2	3	4	5	6
Envision3™	1	2	3	4	5	6
Edge	1	2	3	4	5	6
GreenLITES	1	2	3	4	5	6
Greenroads	1	2	3	4	5	6
Hydropower Sustainability Assessment Protocol	1	2	3	4	5	6
Infrastructure Sustainability	1	2	3	4	5	6
INVEST	1	2	3	4	5	6
STARS	1	2	3	4	5	6

Source: http://fidic.org/node/5943

Question 6: What framework is most commonly used by land conversion professionals to determine <u>building</u> sustainable development goals in land conversion planning and development activities?

BCA Green Mark	☐	GreenLITES	☐	INVEST	☐
CEEQUAL	☐	Greenroads	☐	STARS	☐
Envision3™	☐	Green Globes	☐	HQE Amenagement	☐
BEAM	☐	Green Star (Au)	☐	LEED	☐
BERDE	☐	Green Star (NZ)	☐	NABERS	☐
BREEAM	☐	Green Star (SA)	☐	NatHERS	☐
CalGreen	☐	Greenship	☐	SBTool	☐
CASBEE	☐	GRIHA	☐	Green Building Index	☐
China Ministry of Construction Green Building System	☐	DGNB - the German Sustainable Building Certificate	☐	Estidama & the Pearl Rating System	☐
Edge	☐	Infrastructure Sustainability	☐	Other	☐

Other Frameworks: _____

Source: http://fidic.org/node/5943

Question 7: To what extent to do you perceive the following framework affect sustainability planning and construction?

	Strength of Influence					
	Not at all	**Little**	**Somewhat**	**Quite a bit**	**To a great extent**	**No Opinion**
BCA Green Mark	1	2	3	4	5	6
CEEQUAL	1	2	3	4	5	6
Envision3	1	2	3	4	5	6
BEAM	1	2	3	4	5	6

BERDE	1	2	3	4	5	6
BREEAM	1	2	3	4	5	6
CalGreen	1	2	3	4	5	6
CASBEE	1	2	3	4	5	6
China Ministry of Construction Green Building System**	1	2	3	4	5	6
Edge	1	2	3	4	5	6
GreenLITE	1	2	3	4	5	6
Greenroads	1	2	3	4	5	6
Green Globes	1	2	3	4	5	6
Green Star (Au)	1	2	3	4	5	6
Green Star (NZ)	1	2	3	4	5	6
Green Star (SA)	1	2	3	4	5	6
Greenship	1	2	3	4	5	6
GRIHA	1	2	3	4	5	6
DGNB - the German Sustainable Building Certificate	1	2	3	4	5	6
Infrastructure Sustainability	1	2	3	4	5	6
INVEST	1	2	3	4	5	6
STARS	1	2	3	4	5	6
HQE Amenagement***	1	2	3	4	5	6
LEED	1	2	3	4	5	6
NABERS	1	2	3	4	5	6
NatHERS	1	2	3	4	5	6
SBTool	1	2	3	4	5	6
Green Building Index	1	2	3	4	5	6
Estidama & the Pearl Rating System	1	2	3	4	5	6
Other	1	2	3	4	5	6

Source: http://fidic.org/node/5943

Question 8: What are the barriers of sustainable construction (Zeng, 2013)

Using the scale provided, decide how much you either agree or disagree that sustainable construction barriers are applied to your project. Next to each statement, write the number that best indicates your view.						
1=strongly disagree 5 = strongly agree ? = no opinion	**1**	**2**	**3**	**4**	**5**	**?**
Higher perceived construction costs and green materials costs	1	2	3	4	5	6
Initial costs of executing green design	1	2	3	4	5	6
Incremental cost of green buildings materials over conventional buildings	1	2	3	4	5	6
The high fabrication costs to meet crucial framework requirements	1	2	3	4	5	6
The increased transportation costs of green materials that are often imported	1	2	3	4	5	6
The hard-to-find materials or creating cutting-edge designs	1	2	3	4	5	6
Lack of locally made green building materials	1	2	3	4	5	6
Bad experiences with green building materials	1	2	3	4	5	6
Technical concerns i.e. fire resistance, high requirements for good climate conditions during construction, poor durability etc.	1	2	3	4	5	6
Unwillingness to push the boundary especially when it means shifting from conventional ways of construction which may incur more upfront costs	1	2	3	4	5	6
New technology requirements	1	2	3	4	5	6
Technical difficulties during the construction process and the unfamiliarity with green technologies resulted in delays in the design and construction process of green buildings	1	2	3	4	5	6
Lack of technical workforce and research funding to promote sustainable construction affirming the significant lifecycle benefits and cost savings associated with green buildings	1	2	3	4	5	6
Lack of government subsidies to promote sustainable construction	1	2	3	4	5	6
Lack of government incentives to promote sustainable construction	1	2	3	4	5	6
The incentives provided by the government are often nullified by the prohibitive cost involved in certification	1	2	3	4	5	6
The lack of enforcement and monitoring of law and legislation	1	2	3	4	5	6
The professionals' low environmental and social awareness	1	2	3	4	5	6

Developers in general ignore or even resist environmental initiatives, and few of them have environmental objectives and policies	1	2	3	4	5	6
Fragmented nature of the building supply chain and lack of knowledge between industry professionals about benefits of green procurement, sustainable construction and sustainable development.	1	2	3	4	5	6
Inter-dependency among construction stakeholders will slow down the transformation towards a sustainable industry	1	2	3	4	5	6
Knowledge of all players must be improved to ensure commitment, implementation and participation in achieving sustainable construction	1	2	3	4	5	6
Incompatibility with other building components and higher requirements for materials handling in construction stage	1	2	3	4	5	6
Lack of awareness and demand from end user of building due to insufficient statistical research	1	2	3	4	5	6
Lack of a suitable green building project management framework	1	2	3	4	5	6
Unequal distribution of advantages amongst the developers and tenants or the extra costs incurred for a green building cannot be passed to the tenant readily	1	2	3	4	5	6
Potential that green leases can also be hindered in their uptake if they disrupt or are burdensome to a tenant's primary operations, especially if tenants see little incentive to increase the sustainability of their landowner's property asset	1	2	3	4	5	6
Relatively very few sustainable construction sites which were engaged in measuring energy flows and exchanges	1	2	3	4	5	6
Lack of top management support for adopting green procurement	1	2	3	4	5	6
Lack of environmental missions and strategies in real estate developer	1	2	3	4	5	6
Public interest and their willingness to pay a higher entry cost to enjoy such privilege	1	2	3	4	5	6
Only well-established large firms have the ability, financial capital and capacity to shift from the minimum standards to a more sustainable paradigm. Small and medium organisations are not ready to shift from the minimum standards.	1	2	3	4	5	6

Question 9: Other barriers not mentioned above

Question 10: What strategies can be employed to promote sustainable construction and overcome the barriers in the real estate value chain?

APPENDIX B: Codebook for Sustainable Construction.sav

Full Variable Name	SPSS variable name	Level of Measurement	Coding instructions
Identification	ID	Nominal	Subject identification number
Business Occupation	Occupation	Nominal	1=Architect; 2=Auditor; 3= Construction Manager; 4=Developer / Owner; 5=Financial Services; 6= Government Dept.; 7=Green Building Council; 8= Project Manager; 9 Consulting Engineer; 10= Media; 11=Civil Engineer; 12=Electrical Engineer; 13= Mechanical Engineer; 14=Pavement Engineer; 15=Traffic Engineer; 16=Structural Engineer; 17=Environment Sustainability; 18=Development Manager; 19=Health and Safety; 20=Research Consultant; 21=Hospitality, Travel and Tourism; 22=Landscape Architect; 23=Manufacturing; 24=Quantity Surveyor; 25=Medical Industry; 26=Town Planning; 27=Urban Design; 28=Principal Agent; 29=Client / Employer; 30=Economist
Year Service	YrsServ	Nominal	In years
Sector	Sector	Nominal	1=Retail; 2= Commercial; 3=Industrial; 4=Government; 5= Hospitality; 6=Offices; 7=Residential; 8=Civil Infrastructural; 9= Educational; 10=Other
Infrastucture Framework	INFRAM	Nominal	1=BCA Green Mark; 2= CEEQUAL; 3=Envision3; 4=Other; 5=Edge; 6=GreenLITES; 7=Greenroads; 8=Infrastructure Sustainability; 9=INVEST; 10=STARS
BCA	INFLI01	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
CEEQUAL	INFLI02	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion

Full Variable Name	SPSS variable name	Level of Measurement	Coding instructions
ENVISION3	INFLI03	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
EDGE	INFLI04	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
GreenLITES	INFLI05	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
Greenroads	INFLI06	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
Hydropower Sustainabiility	INFLI07	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
InfrastructureSustainability	INFLI08	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
INVEST	INFLI09	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
STARS	INFLI10	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
Building Framework	BUILFR1	Nominal	1=BCA Green Mark; 2=CEEQUAL; 3=Envision3; 4=BEAM; 5=BERDE; 6=BREEAM; 7=CalGreen; 8=CASBEE; 9=China Ministry of Construction Green Building System; 10=Edge; 11=GreenLITES; 12=Greenroads; 13=Green Globes; 14=Green Star (Au); 15=Green Star (NZ); 16=Green Star (SA); 17=Greenship; 18=GRIHA; 19=DGNB - the German Sustainable Building Certificate; 20=Infrastructure Sustainability; 21=INVEST; 22=STARS; 23=HQE Amenagement; 24=LEED; 25=NABERS; 26=NatHERS; 27=SBTool; 28=Green Building Index; 29=Estidama & the Pearl Rating System; 30=Other

Full Variable Name	SPSS variable name	Level of Measurement	Coding instructions
Building Framework	BUILFR2	Nominal	1=BCA Green Mark; 2=CEEQUAL; 3=Envision3; 4=BEAM; 5=BERDE; 6=BREEAM; 7=CalGreen; 8=CASBEE; 9=China Ministry of Construction Green Building System; 10=Edge; 11=GreenLITES; 12=Greenroads; 13=Green Globes; 14=Green Star (Au); 15=Green Star (NZ); 16=Green Star (SA); 17=Greenship; 18=GRIHA; 19=DGNB - the German Sustainable Building Certificate; 20=Infrastructure Sustainability; 21=INVEST; 22=STARS; 23=HQE Amenagement; 24=LEED; 25=NABERS; 26=NatHERS; 27=SBTool; 28=Green Building Index; 29=Estidama & the Pearl Rating System; 30=Other
Building Framework	BUILFR3	Nominal	1=BCA Green Mark; 2=CEEQUAL; 3=Envision3; 4=BEAM; 5=BERDE; 6=BREEAM; 7=CalGreen; 8=CASBEE; 9=China Ministry of Construction Green Building System; 10=Edge; 11=GreenLITES; 12=Greenroads; 13=Green Globes; 14=Green Star (Au); 15=Green Star (NZ); 16=Green Star (SA); 17=Greenship; 18=GRIHA; 19=DGNB - the German Sustainable Building Certificate; 20=Infrastructure Sustainability; 21=INVEST; 22=STARS; 23=HQE Amenagement; 24=LEED; 25=NABERS; 26=NatHERS; 27=SBTool; 28=Green Building Index; 29=Estidama & the Pearl Rating System; 30=Other
Building Framework	BUILFR4	Nominal	1=BCA Green Mark; 2=CEEQUAL; 3=Envision3; 4=BEAM; 5=BERDE; 6=BREEAM; 7=CalGreen; 8=CASBEE; 9=China Ministry of Construction Green Building System; 10=Edge; 11=GreenLITES; 12=Greenroads; 13=Green Globes; 14=Green Star

Full Variable Name	SPSS variable name	Level of Measurement	Coding instructions
			(Au); 15=Green Star (NZ); 16=Green Star (SA); 17=Greenship; 18=GRIHA; 19=DGNB - the German Sustainable Building Certificate; 20=Infrastructure Sustainability; 21=INVEST; 22=STARS; 23=HQE Amenagement; 24=LEED; 25=NABERS; 26=NatHERS; 27=SBTool; 28=Green Building Index; 29=Estidama & the Pearl Rating System; 30=Other
BCA Green Mark	INFBUI1	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
CEEQUAL	INFBUI2	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
Envision3TM	INFBUI3	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
BEAM	INFBUI4	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
BERDE	INFBUI5	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
BREEAM	INFBUI6	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
CalGreen	INFBUI7	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
CASBEE	INFBUI8	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
China Ministry of Construction green Building System	INFBUI9	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
Edge	INFBUI10	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion

Full Variable Name	SPSS variable name	Level of Measurement	Coding instructions
GreenLITE	INFBUI11	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
Greenroads	INFBUI12	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
Green Globes	INFBUI13	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
Green Star (Au)	INFBUI14	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
Green Star (NZ)	INFBUI15	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
Green Star (SA)	INFBUI16	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
Greenship	INFBUI17	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
GRIHA	INFBUI18	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
DGNB - the German Sustainable Building Certificate	INFBUI19	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
Infrastructure Sustainability	INFBUI20	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
INVEST	INFBUI21	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
STARS	INFBUI22	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
HQE Amenagement	INFBUI23	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
LEED	INFBUI24	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion

Full Variable Name	SPSS variable name	Level of Measurement	Coding instructions
NABERS	INFBUI25	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
NatHERS	INFBUI26	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
SBTool	INFBUI27	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
Green Building Index	INFBUI28	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
Estidama & the Pearl Rating System	INFBUI29	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
Other	INFBUI30	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
Higher perceived construction costs and green material costs	BARR1	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
Initial costs of executing green design	BARR2	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
Incremental cost of green building materials over conventional buildings	BARR3	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
high fabrication costs to meet crucial	BARR4	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion

Full Variable Name	SPSS variable name	Level of Measurement	Coding instructions
framework requirements			
increased transportation costs of green material that are often imported	BARR5	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
the hard to find materials or creating cutting-edge designs	BARR6	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
lack of locally made green building materials	BARR7	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
bad experiences with green building materials	BARR8	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
technical concern	BARR9	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
unwillingness to push the boundary from conventional construction	BARR10	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion

Full Variable Name	SPSS variable name	Level of Measurement	Coding instructions
New technology requirements	BARR11	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
technical difficulties during construction and unfamilarity with green technologies	BARR12	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
Lack of technical workforce and research funding	BARR13	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
Lack of government subsidies	BARR14	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
Lack of government incentives	BARR15	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
Incentitive provided by govt. often nullified by the prohibitive cost involved in certification	BARR16	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
Lack of enforcement	BARR17	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion

Full Variable Name	SPSS variable name	Level of Measurement	Coding instructions
and monitoring of law and legislation			
The professional low environmental and social awareness	BARR18	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
Developers in general ignore or even resist environmental initiatives	BARR19	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
Fragemented nature of the building supply chain and lack of knowledge between industry professionals about benefits of green procurement, sustainable construction and sustainable development	BARR20	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
Inter-dependency	BARR21	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion

Full Variable Name	SPSS variable name	Level of Measurement	Coding instructions
among construction stakeholders slow down the transformation toward sustainability			
Knowledge of all players must be improved to ensure commitment, implementation and participation in achieving sustainable construction	BARR22	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
Incompatibility with other building components and higher requirements for materials handling in construction stage	BARR23	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
Lack of awareness and demand from	BARR24	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion

Full Variable Name	SPSS variable name	Level of Measurement	Coding instructions
end user of building due to nsufficient statistical research			
Lack of suitable green building project management framework	BARR25	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
Unequal distribution of advantages amongst the developers and tenant or the extra costs incurred for a green building cannot be passed to the tenant readily	BARR26	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
Potential that green leases can also be hindered in their uptake if they disrupt or are burdensome to a tenant's	BARR27	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion

Full Variable Name	SPSS variable name	Level of Measurement	Coding instructions
primary operations, especially if tenants see little incentive to increase the sustainability of their landowner's property asset			
Relatively very few sustainable construction sites which were engaged in measuring energy flows and exchanges	BARR28	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
Lack of top management support for adopting green procurement	BARR29	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
Lack of environmental missions and strategies in real estate developer	BARR30	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
Public interest and their	BARR31	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion

Full Variable Name	SPSS variable name	Level of Measurement	Coding instructions
willingness to pay a higher entry cost to enjoy such privilege			
Only large firms would have the capability to go beyond the minimum standard	BARR32	Ordinal	1=Not at all; 2=Little; 3=Somewhat; 4=Quite a bit; 5=To a great extent; 6=No Opinion
Other	Other	Ordinal	
Strategies	Strategies	Ordinal	

APPENDIX C: Consent Form

CONSENT FORM

UNIVERSITY OF CAPE TOWN

CONSENT TO PARTICIPATE IN A RESEARCH

INFORMATION SHEET & CONSENT FORM

Target Group: Sibaya Coastal Precinct – Land Conversion Professional Team / Design Team / Developer / Building and Structure Professional Team / Developer Contractors Professional Team

Enabling Sustainable Construction in the Real Estate Value Chain through Land Conversion Planning and Development Activities

Dear potential participant,

Hello, my name is Dean Young, and I am conducting research towards a master's degree at the University of Cape Town. I am researching the barriers and constraints of sustainable construction in the land conversion sector of the real estate value chain and would like to invite you to participate in the research study.

The research is supervised by Associate Professor Kathy Michell of the University of Cape Town and the results of the study will be presented to the Department of Construction Economics and Management in fulfillment of the requirements for the degree of Master of Property Studies in Construction Economics and Management.

If you have any question or concern about the research, please feel free to contact me, Dean Young, anytime at +27 83 378 5438 or deanyoung@hotmail.co.za. The research supervisor, Associate Professor Kathy Michell, may also be contacted at Kathy.Michell@uct.ac.za.

Purpose of the study

The primary aim of this research is to establish the foundation necessary for sustainable construction practices in the real estate value chain. To this end, it will examine the knowledge and understanding of agricultural land conversion real estate developers in adopting sustainable construction in real estate development within the context of South Africa real estate business environment and examines the gap and barriers between knowledge and implementation.

Procedures

I am interested in finding out whether, with greater collaboration, sustainable construction practices can increasingly be adopted in South Africa in the real estate value chain to promote a more sustainable future.

Your participation in this study is voluntary. If you volunteer to participate in the study, we would consult you to agree a time that would be suitable for a face-to-face interview. Pre-established probing as well as emergent questions will be asked that will be use to supplement data gathered from document analysis under a case study research setup.

Please understand that you do not have to participate, i.e. your participation is voluntary. The choice to participate is yours alone. If you choose not to participate, there will be no negative consequence. If you choose to participate, but wish to withdraw at any time, you will be free to do so without negative consequence. However, I would be grateful if you would assist me by allowing me to interview you.

Expectation of participants

Participants will be asked to answer several questions that is likely to take 5 mins to complete and subsequently interviewed for approximately 15mins, in the unlikely event that transport is required, you will be reimbursed for the kilometres travelled at the AA rate and any payment/reimbursement. Interview recording will be at your discretion.

Potential benefits to participants

At your request, the research findings will be shared to you.

The risk of harm to participants

Please note that during the interview you may experience some discomfort as various topics are explored, I would ask that your bear with me as the findings will help to journey towards a more sustainable future.

Level of permission required

The participant can specify what you will allow to be used in the research and will be given the opportunity to edit recordings to censor portions after the recording or to request that the recording is deleted.

Where the research findings are shared with you, the finding will only be for your benefit and may not be used or relied upon by third parties or outside parties.

Anonymity and Confidentiality

Please be assured that your identity will not be shared outside of this research. Each participant will be coded with using focus grouping. There is some weakness in this that the sample size will be relatively small for each group and by deduction your identity can be guessed. Confidentiality will be preserved using by mixing the focus groups and presenting the general findings in the data analysis section of the findings. To keep the identity of the person being interviewed anonymous and confidential several measures will be taken. Firstly, each interviewee shall be assigned a four-character code, consisting of two letters and two numbers e.g. IN01. These codes shall be randomly assigned and have no relation to persons personal information. No information regarding the time or place of the interview taking place shall be given out or posted on social media. Any personal information of the interviewee, including their contact details, will not be given out without the person's permission. No pictures of the person will be taken. The privacy of the interviewee will be respected and no personal questions which have not relevance to the study will be asked. Non-essential questions which may reveal the identity of the person will be avoided.

Only the researcher and supervising Associate Professor and academic supervisor will have access to the information gathered and the file which relates the code of the interviewee to their actual personal identity. This file will have restricted access and no outside person will have access to it.

Sharing and use of data

Feedback to participants is possible. Should you want supplemental information related to this research report, please do not hesitate to contact me on 083 378 5438 or via email deanyoung@hotmail.co.za

_____

Name of Participant (please print)

_____

Date

_____

Company of Participant

_____

Signature of Participant

APPENDIX D: Survey Response (Example)

Research Questionnaire:

Background:

Question 1- Please indicate your primary business occupation. Please select only one option:

Architect		Engineering - Civil		Hospitality, Travel and Tourism			
Auditor		Engineering - Electrical		Landscape Architect			
Construction Manager		Engineering - Mechanical		Manufacturing			
Developer / Owner		Engineering - Pavement		Quantity Surveyor			
Financial Services		Engineering - Traffic		Medical Industry			
Government Dept.		Engineering - Structural		Town Planning			
Green Building Council		Environmental Sustainability		Urban Design			
Project Manager		Development Manager		Principle Agent			
Consulting Engineer		Health and Safety		Client / Employer	✓		
Media		Research Consultant		Economist			

Source: https://www.edgebuildings.com/edge-experts/online-training/

Question 2 - How long have you been working in the field of real estate? Number of years

30 years

Question 3 - Which sector of the real estate do you predominantly service?

Retail		Hospitality		Educational	
Commercial		Offices		Other	
Industrial		Residential	✓	All	
Government		Civil Infrastructural			

Source: https://www.edgebuildings.com/edge-experts/online-training/

Study

Question 4 : What framework is most commonly used by land conversion professionals to determine infrastructural sustainable development goals in land conversion planning and development activities? (Engineers, 2019)

BCA Green Mark		Edge		INVEST	
CEEQUAL		GreenLITES		STARS	
Envision3™		Greenroads		Other	✓
Other		Infrastructure Sustainability	✓		

Other Frameworks:_____

Source: http://fidic.org/node/5943

Question 5: To what extent to do you perceive the following frameworks affect <u>infrastructural</u> sustainability planning and construction?

	Strength of Influence					
	Not at all	Little	Somewhat	Quite a bit	To a great extent	No Opinion
BCA Green Mark	1	2	3	4	5	6
CEEQUAL	1	2	3	4	5	6
Envision3™	1	2	3	4	5	6
Edge	1	2	3	4	5	6
GreenLITES	1	2	3	4	5	6
Greenroads	1	2	3	4	5	6
Hydropower Sustainability Assessment Protocol	1	2	3	4	5	6
Infrastructure Sustainability	1	2	3	4	5	6
INVEST	1	2	3	4	5	6
STARS	1	2	3	4	5	6

Source: http://fidic.org/node/5943

Question 6: What framework is most commonly used by land conversion professionals to determine <u>building</u> sustainable development goals in land conversion planning and development activities?

BCA Green Mark	☐	GreenLITES	☐	INVEST	☐
CEEQUAL	☐	Greenroads	☐	STARS	☐
Envision3™	☐	Green Globes	☐	HQE Amenagement	☐
BEAM	☐	Green Star (Au)	☐	LEED	☐
BERDE	☐	Green Star (NZ)	☐	NABERS	☐
BREEAM	☐	Green Star (SA)	☑	NatHERS	☐
CalGreen	☐	Greenship	☐	SBTool	☐
CASBEE	☐	GRIHA	☐	Green Building Index	☐
China Ministry of Construction Green Building System.	☐	DGNB - the German Sustainable Building Certificate	☐	Estidama & the Pearl Rating System	☐
Edge	☐	Infrastructure Sustainability	☐	Other	☐

Other Frameworks: _____

Source: http://fidic.org/node/5943

Question 7: To what extent to do you perceive the following framework affect sustainability planning and construction?

	Strength of Influence					
	Not at all	Little	Somewhat	Quite a bit	To a great extent	No Opinion
BCA Green Mark	1	2	3	4	5	6
CEEQUAL	1	2	3	4	5	6
Envision3	1	2	3	4	5	6
BEAM	1	2	3	4	5	6
BERDE	1	2	3	4	5	6
BREEAM	1	2	3	4	5	6
CalGreen	1	2	3	4	5	6
CASBEE	1	2	3	4	5	6
China Ministry of Construction Green Building System**	1	2	3	4	5	6
Edge	1	2	3	4	5	6
GreenLITE	1	2	3	4	5	6
Greenroads	1	2	3	4	5	6
Green Globes	1	2	3	4	5	6
Green Star (Au)	1	2	3	4	5	6
Green Star (NZ)	1	2	3	4	5	6
Green Star (SA)	1	2	3	4	5	6
Greenship	1	2	3	4	5	6
GRIHA	1	2	3	4	5	6
DGNB - the German Sustainable Building Certificate	1	2	3	4	5	6
Infrastructure Sustainability	1	2	3	4	5	6
INVEST	1	2	3	4	5	6
STARS	1	2	3	4	5	6
HQE Amenagement***	1	2	3	4	5	6
LEED	1	2	3	4	5	6
NABERS	1	2	3	4	5	6
NatHERS	1	2	3	4	5	6
SBTool	1	2	3	4	5	6
Green Building Index	1	2	3	4	5	6
Estidama & the Pearl Rating System	1	2	3	4	5	6
Other	1	2	3	4	5	6

Source: http://fidic.org/node/5943

Question 8: What are the barriers of sustainable construction (Zeng, 2013)

Using the scale provided, decide how much you either agree or disagree that sustainable construction barriers are applied to your project. Next to each statement, write the number that best indicates your view.

1=strongly disagree 5 = strongly agree ? = no opinion	**1**	**2**	**3**	**4**	**5**	**?**
Higher perceived construction costs and green materials costs	1	2	3	4	(5)	6
Initial costs of executing green design	1	2	(3)	4	5	6
Incremental cost of green buildings materials over conventional buildings	1	2	3	(4)	5	6
The high fabrication costs to meet crucial framework requirements	1	2	(3)	4	5	6
The increased transportation costs of green materials that are often imported	1	(2)	3	4	5	6
The hard-to-find materials or creating cutting-edge designs	1	(2)	3	4	5	6
Lack of locally made green building materials	1	(2)	3	4	5	6
Bad experiences with green building materials	(1)	2	3	4	5	6
Technical concerns i.e. fire resistance, high requirements for good climate conditions during construction, poor durability etc.	1	2	(3)	4	5	6
Unwillingness to push the boundary especially when it means shifting from conventional ways of construction which may incur more upfront costs	1	2	3	(4)	5	6
New technology requirements	1	(2)	3	4	5	6
Technical difficulties during the construction process and the unfamiliarity with green technologies resulted in delays in the design and construction process of green buildings	1	(2)	3	4	5	6
Lack of technical workforce and research funding to promote sustainable construction affirming the significant lifecycle benefits and cost savings associated with green buildings	1	2	3	(4)	5	6
Lack of government subsidies to promote sustainable construction	1	2	(3)	4	5	6
Lack of government incentives to promote sustainable construction	1	2	(3)	4	5	6
The incentives provided by the government are often nullified by the prohibitive cost involved in certification	1	2	(3)	4	5	6
The lack of enforcement and monitoring of law and legislation	1	(2)	3	4	5	6
The professionals' low environmental and social awareness	1	(2)	3	4	5	6
Developers in general ignore or even resist environmental initiatives, and few of them have environmental objectives and policies	1	(2)	3	4	5	6
Fragmented nature of the building supply chain and lack of knowledge between industry professionals about benefits of green procurement, sustainable construction and sustainable development.	1	2	3	(4)	5	6
Inter-dependency among construction stakeholders will slow down the transformation towards a sustainable industry	1	(2)	3	4	5	6
Knowledge of all players must be improved to ensure commitment, implementation and participation in achieving sustainable construction	1	2	3	4	(5)	6
Incompatibility with other building components and higher requirements for materials handling in construction stage	1	(2)	3	4	5	6
Lack of awareness and demand from end user of building due to insufficient statistical research	1	2	3	(4)	5	6
Lack of a suitable green building project management framework	1	(2)	3	4	5	6
Unequal distribution of advantages amongst the developers and tenants or the extra costs incurred for a green building cannot be passed to the tenant readily	1	(2)	3	4	5	6

Potential that green leases can also be hindered in their uptake if they disrupt or are burdensome to a tenant's primary operations, especially if tenants see little incentive to increase the sustainability of their landowner's property asset	1	2	3	(4)	5	6
Relatively very few sustainable construction sites which were engaged in measuring energy flows and exchanges	1	(2)	3	4	5	6
Lack of top management support for adopting green procurement	1	2	3	(4)	5	6
Lack of environmental missions and strategies in real estate developer	1	2	3	(4)	5	6
Public interest and their willingness to pay a higher entry cost to enjoy such privilege	1	2	(3)	4	5	6
Only well-established large firms have the ability, financial capital and capacity to shift from the minimum standards to a more sustainable paradigm. Small and medium organisations are not ready to shift from the minimum standards.	1	2	3	(4)	5	6

Question 9: Other barriers not mentioned above

Continuity in the "green" chain of development.
Eg (Separating refuse only to be dumped in one landfill)
(Cycle paths provided but no cycle parking at destinations & vice versa).

Question 10: What strategies can be employed to promote sustainable construction and overcome the barriers in the real estate value chain?

Strong, continuous marketing of all sustainable projects, particularly those that are high profile &/or iconic with which people identify & like to be associated.

Give credit to groups of people where credit is due - people drive sustainability - not processes, rules & frameworks.

APPENDIX E: Interview Transcripts (Example)

Interview with Interviewee 02 July 2019

Interviewer: Hi Interviewee are you OK to talk?

Interviewee: Yes sure!

Interviewer: Thanks very much for agreeing to this interview. do you mind if I record this?

Interviewee: No that's fine!

Interviewer: thanks very much. Interviewee just to give you some background I'm a masters student at the University of Cape Town and I'm studying sustainable construction in the real estate value chain. I was given you your name, who recommended I, don't know if you recall? Well he recommended that I get in touch with you and I was wondering whether you had managed to have a look at my research consent form and questionnaire?

Interviewee: I sort of, I looked at them and I did not complete the questionnaire. I confess haven't managed to get to that

Interviewer: I understand. Do you mind if we go through it?

Interviewee: I assume you need to do that before we kick off

Interviewer: yeah, we can discuss as we go along nothing, for I'm researching the barriers to sustainable construction predominantly in the land conversion side of the development process, looking from an agricultural land to urban use. I know the Green Building Council had done similar study but more focused on green buildings and where my thesis is targeted at is the infrastructural side of things. And I know that the green building council is currently developing the sustainable precincts rating tool kit.

Interviewee: yeah just to clarify I'm intrigued by your topic around land conversion. So, you may get into this a little bit further down the track, but I would like to understand how the you're questioning the barriers to sustainable construction in a context of land conversion. It is not a topic that I've encountered before. Typically, the barriers to sustainable construction focus on things like the cost, the premium associated with building green and sometimes it looks at that that perception to benefits, operating costs but not land conversion, so if you can unpack that for me a little bit, I would appreciate it.

Interviewer: Okay, It is very similar to the study, well when I started didn't know that the green building council had done a study on green buildings and the barriers but after speaking with xxx he had mentioned that the green building council had done their report called the Rands and Sense of Green Buildings And it was very interesting to read that report afterwards because a lot of the findings that coming out of that well that came out of that Rands and Sense of Green Buildings is very applicable to the barriers to sustainable construction in the land conversion side of things. So, I have read quite a lot of literature on land conversion and also on green buildings. So, looking at a lot of the themes that have come out of those literature review, I've basically taken out what the literature saying about the barriers and what's impeding sustainable construction and green buildings in general and then have interviewed guys that are specifically focused on land conversion because like Tongaat Hulett they look specifically at land conversion to urban use and then based on that I used the case studies that, of 3 developments and interviewing professional that have worked on in those case studies. So, that is how I've been studying the barriers to sustainable construction and just asking them for their opinion and what can be done to promote sustainable construction and development.

Interviewee: OK thank you that is helpful context. Do you need to talk through the consent form or do I just need to sign off after the interview when we finish, and send it to you?

Interviewer: yes please! do you want to go through the consent form?

Interviewee: No, I am happy to sign it and send it back. I had a quick look at it, there's nothing there that I had a problem with, I just need to sign it and send it back. I'm happy to jump into the meat of what you wanted to talk about now.

Interviewer: Thanks very much, the 1st question is: Please indicate the primary occupation?

Interviewee: Green Building Council, that is us and professional background is Architectural.

Interviewer: Thank you. How long have you, 2nd question is, how long have you worked in the field of real estate?

Interviewee: uh so including my architectural experience my management consulting experience and my current experience approximately 15 years.

Interviewer: OK wow, OK which sector of the real estate do you predominantly service? Is it all or specifically on commercial retail or industrial?

Interviewee: At the moment it is all. That includes public sector

Interviewer: perfect OK what framework is most commonly used by land conversion professional city common infrastructural sustainable development goals in land conversion planning? Are you aware of any of these frameworks?

Interviewee: I'm aware of some I'm not aware of them being widely applicable, applied

Interviewer: OK

Interviewee: so, the one that we're most familiar with the green building council is sustainable urban precincts framework which you probably aware of, would've probably researched that seen that it is available as a certification through green building council and that we offer training on it. So that is the framework that the Green Building Council most aware of. The frameworks typically applied to my knowledge for new urban development and land conversion is the local authority frameworks. So, the spatial development framework (SDF) and so on that are available through the local authorities are what is usually provided and to my knowledge they don't comprehensively address sustainable development.

Interviewer: OK thanks. In Australia they are using the Infrastructures Sustainability as kind of their framework and I was just wondering whether the green building council is maybe using that as inputs into the sustainable precincts rating tool.

Interviewee: yeah so, the sustainable precincts rating tool is developed from the Australian, I think it's, communities rating tool, sustainable communities rating tool which draws on the infrastructure Sustainability framework that they have in Australia. In a roundabout way that answer to your question is yes. The framework that we reference are linked back to that infrastructure sustainability framework that the Australians use. Having said that, I am sure xxx would have said as well that we don't simply cut and paste the Australians systems. We always completely review them for local context yeah affect

Interviewer: I know that the Americans also using Envision3 as their guide for infrastructure.

Interviewee: I am not similar with that. Is that Envision with an e or…?

Interviewer: it's with an "e" that is option #3

Interviewee: OK I'm not familiar with that, I should look at it and see what is involved there.

Interviewer: question 5 is to what extent do you perceived the following framework was affecting infrastructure sustainability planning. I think, should I just say no opinion here or? This is

just measuring the strength of influence, 'cause a lot of these frameworks are used as input into local frameworks.

Interviewee: just to clarify your question, are you asking me what impact I think these frameworks are having on local infrastructure development?

Interviewer: yes yeah

Interviewee: At present I think it is very limited. There are a handful of developments, and I suspect they are the ones that you have researched, where frameworks are being applied but for the vast majority not.

Interviewee: does that give you something you can put into the box?

Interviewer: not at all or little?

Interviewee: Little

Interviewer: OK, I'll just ring all of them as little

Interviewee: OK

Interviewer: thanks. OK in terms of the building side of things so question six is what framework is most commonly used by land conversion a professional to determine building sustainability development goals in the land conversion planning and development activities? Most of the professionals have been indicating the green star for buildings

Interviewee: I think it's important to add the subjects that subjects that where the sustainability principles of being applied the most commonly used framework is Green Star. We would like to see a much bigger reach for Green Star than what we currently see but what we are pleased about is that the market is largely dominated by Green Star. There is limited application of other frameworks developed from other countries.

Interviewer: So, it's always good to have it under one house rather than having multiple rating system.

Interviewee: Certainly, the majority is at the moment. It does help to create clarity in the market, you don't want to diluted things too much. Having said that we believe that our mandate is to convert the built environment to be more sustainable, not just to implement Green Star. So, if there are other certification systems out there that are being used, that doesn't make the buildings less green, or the precincts less green or the infrastructure less green. I am happy to mention that as well.

Interviewer: yeah, yeah and OK! any influence of the green building index? Is that something that strikes a chord with you?

Interviewee: The Green Building Index?

Interviewer: Yes, so the MSCI would have like a…

Interviewee: Yes right, yes yes yes. Are you asking what the influence of the Green Building Framework on the Green Building Index?

Interviewer: I am asking whether, if the Green Building Index is a common framework used for buildings.

Interviewee: it is not a common framework, but it is a common research source and piece of thought leadership that is frequently referred to. The MSCI green building index is never developed, it was developed as a metric measurement of performance to that end it is frequently referred to but is not framework as such, but it is a very very valuable information source to us and to the markets

Interviewer: OK any other these frameworks that you think are commonly used? So, there is LEED

Interviewee: in the residential sector Edge and his quite commonly used

Interviewer: OK that's we've got that one yeah at the bottom of the first column right at the bottom.

Interviewee: I don't have it in front of me I should i get that in front of me would it help

Interviewer: Yes, it would help

Interviewee: okay just hold on a second. I can just hold…. OK I've got it. when we are communicating seemed like the perfect time and I haven't got

Interviewer: I called a bit early, that's on the questionnaire, I think it's page 2 of the questionnaire question 6.

Interviewee: let me make sure I get the right, okay page 2 question 6, okay you have the frameworks listed there. Shoo… they seem to be all here.

Interviewer: so, at the bottom, the ones in have ticked at the moment is Edge, which is the first column right at the bottom, then I have ticked Green Star SA and then on the last column the 3rd column is the green building index. Are any of the other frameworks familiar to you?

Interviewee: not for application in South Africa.

Interviewer: okay question 7 is to what extent do you perceive the following frameworks to affect sustainable planning and construction in a South African context? The first one is the BCA Green Mark. Is there a strong influence? not at all or to a great extent?

Interviewee: not at all! I think it's easier to simply identify where there is an interest because they mostly “not at all”. So, for Green Star I would say somewhat.

Interviewer: Green Star SA?

Interviewee: Yes, Green Star, somewhat, and Edge I would say little and Green Building Index somewhat.

Interviewer: and all the others is not at all?

Interviewee: Yes, sorry LEED should be little, no there is more LEED than Edge I mean there is more Edge than there is LEED. There’s a handful of LEED projects in the country and they have influenced some of the multinationals. To that end, you see if I look at all sustainability and planning and construction, we are a small influence so I can't really say anything that is listed here is more than somewhat. I think it can go to a four, which makes it difficult to score LEED. LEED is such a small tiny influence.

Interviewer: So little?

Interviewee: less than little. I guess you can make LEED little and Edge somewhat and Green Star somewhat.

Interviewer: what do you think the most influential framework then? The Green Star?

Interviewee: The Green Star.

Interviewer: Question 8 is really where the crux of my thesis is, looking at the barriers to sustainable construction and what else can be done to overcome these barriers. So, the first barrier and the range is one is strongly disagree and 5 is strongly agree. Six is no opinion, the first barrier high perceived construction costs in green material costs and construction costs

Interviewee: I strongly agree that that is a barrier.

Interviewer: the initial cost of executing green design?

Interviewee: I think that's a that's a two because it's actually a lot lower than a lot of people think

Interviewer: yeah, yeah, it's surprising that because when I started my research, I actually thought it was much higher than that, but the research is showing

Interviewee: the common perception is around 20%. The reality is it is a lot closer to 5% and sometimes even less.

Interviewer: OK the incremental cost of green building materials over conventional buildings

Interviewee: that's two for me because it's very similar to the previous question

Interviewer: yeah, the fabrication costs to meet crucial framework requirements?

Interviewee: So, there are very few fabrication costs associated with the framework requirements because most of the products and services are available off the shelf, actually, to achieve green design. It is just a question of investing up front in the right professional services. So, I would give that a two. Maybe, I should go back to the initial cost of executing green design, does that include professional services fees.

Interviewer: yeah

Interviewee: I would give that a 3. Because you do have to invest more upfront to achieve the requirements of the green framework, whereas the actual implementation costs in other words incremental cost in green building and fabrication cross can just be twos.

Interviewer: OK. The increased transportation costs of green materials that are often imported as a barrier

Interviewee: I honestly think that is a 1. If you look at the balance of products imported to products locally sourced, the only products that are imported are the high-tech products that are imported whether they are green or non-green. So, really, I think that has absolutely no impact on the actual transportation costs

Interviewer: okay, perfect! The hard to find materials and or creating cutting edge designs?

Interviewee: Again, you know globally the construction industry has made cutting-edge materials and products available and technologies available freely or widely I should say. So, for me that has minimal impact. I disagree with that. That's a, that's a two for me.

Interviewer: the lack of locally made green building materials we said that that that's not a barrier

Interviewee: so, if you are sourcing locally, if you are targeting locally made materials that could be a problem. So that is a slightly different from what I was saying earlier. What I am saying is that globally the materials are available so you can always access them. If you're wanting to reduce your carbon footprint of transport and source locally made materials it could be tricky because you are sourcing something for a local market and limiting yourself to

the local markets instead of accessing the wider market. Having said that you don't always reduce your carbon footprint because we use very high carbon energy to manufacture locally so it can be a red herring. I'd give that a three.

Interviewer: Bad experiences with green building materials?

Interviewee: So, I'm going to give that as 3. It is a moderate risk, a moderate barrier because of poor implementation. Solar water heaters in the residential sector is a good example of that. Poorly installed and poorly designed and low-quality solar water heaters have given that industry a bad reputation. It doesn't mean it is a bad idea, just a bad experience due to bad specification.

Interviewer: OK, technical concerns the fire resistance and oh hi requirements who could climate conditions during construction or the poor durability?

Interviewee: That's a perception more than a reality, so for me that's a two.

Interviewer: the unwillingness to push the boundary especially when it comes when it means shifting from conventional ways of construction which may incur more upfront costs

Interviewee: as the way you have written it there as an unwillingness to push the boundary, I strongly agree. I think it is actually a four. Because, because there is definitely some way to go to convert levels of awareness around what it actually means to shift from convention so there are a lot of entrenched views that bring about that, so I agree with that.

Interviewer: New technology requirements?

Interviewee: it's quite a broad statement, what do you mean by that?

Interviewer: so sometimes when we trying to implement knew sustainable construction methods it required new technology a new way of constructing

Interviewee: so, I would say that's only really a barrier in the residential sector, because there is a very entrenched skill there around masonry construction. Tradition construction. I would say that the 3. The others I don't think it is a barrier. I would say it is a 3. Having said that the construction industry is a relatively slower adopter for new technologies, so I would give that a 3.

Interviewer: technical difficulties during the construction process and the unfamiliarity with green technologies resulting in delays in the design and construction process of green buildings. It depends what sector you're looking at. So, in the office, the premium grade office later

that's absolutely not a barrier. In other, some other sectors it can be because there are fewer tried ended tested construction processes there. So, barrier is also so dependent on the team involved in the construction process and their willingness to implement and learn. What a tough one. Across the board, I would say it is a 3. In the commercial office sector, I would say 1. I don't know if you can differentiate that position, but I am happy to position it that way.

Interviewer: I will put one for commercial

Interviewee: commercial premium grade office typically.

Interviewer: and then a 3 for the others. The lack of technical workforce and research funding to promote sustainable construction affirming the significant lifecycle benefits and cost saving associated with green buildings. So, not enough research in this area.

Interviewee: that is definitely something that is a barrier and then we're trying to, trying to address it. So, that is a 3.

Interviewer: the lack of government subsidies to promote sustainable construction?

Interviewee: five 5

Interviewer: I suppose that's with the incentives as well

Interviewee: yeah, wouldn't that transform things. I mean you mentioned the US and some of the things that came. I mean that is such an enabled for change. I mean didn't [the president] mention that in the nation address that, and so that's promising but we haven't seen any action from Treasury yet

Interviewer: well let's hope that comes through in some kind of legislation and regulations that

Interviewee: yeah,

Interviewer: OK then the incentives provided by governments are often nullified by the prohibitive costs incurred in certification?

Interviewee: I would call it the costs of certification, it's the cost of accessing the incentive. I think if you take the part 12L tax incentive, I don't know if you have looked at that. The cost of accessing that is quite prohibitive. So, I take issue with the fact that you said the cost of certification. I think it is the cost of accessing the incentive is a prohibitive factor.

Interviewer: So, strongly disagree?

Interviewee: I can't say that because, because the incentives provided by government are often nullified by something, is just not that. Can I have a no opinion on that one

Interviewer: a qualification?

Interviewee: you can call it that

Interviewer: thanks. The lack of enforcement and monitoring of law and legislation.

Interviewee: So, that I mean technically speaking that doesn't affect the green and sustainable framework because they operate independently from law and legislation and they are independently enforced and monitored. So, nobody gets a Green Star certification without a careful review of their information by the GBCSA. Plenty of buildings pass through building planning and building inspection without proper monitoring in it. So, yeah that is an issue, but I don't think it is a barrier to green it is just a general barrier to quality buildings

Interviewer: OK,

Interviewee: so, without being able to modify the question, I might have to go for six again. I don't understand how it relates to green sustainable construction. I would actually say, you know if you could if you say if you take law and legislation as the framework standards, then I strongly disagree because those are all robustly enforced. So, I would either say a 1 or a 6, in am not sure how you are handling your questions. It depends which way I've interpreted it

Interviewer: because generally you would want the legislation to be there and then that would drive the sustainable construction. Without the legislation itself, it is very hard driving the enforcement of sustainable construction.

Interviewee: so, we see it the other way around. The introduction of green building frameworks and sustainable construction frameworks actually has the ability to inform law and legislation and bring about a change there to more sustainable policies being introduced. Yeah, so I mean if you take the SANS 10400, it's not properly enforced, there is no doubt about it, but that doesn't impact the Green frameworks because the Green Frameworks acts over and above that

Interviewer: yeah,

Interviewee: I'm going to go with a 6 please.

Interviewer: OK the professionals low environmental and social awareness?

Interviewee: professionals are generally pretty good, so I would say that is a 2.

Interviewer: OK developers in general ignore and often resist environmental incentives and few of them have environmental objectives and policies.

Interviewee: a 4, I agree with that.

Interviewer: OK, the fragmented nature of buildings supply chain and the lack of knowledge between the industry professionals about the benefits of green procurement, sustainable construction and sustainable development.

Interviewee: So, there is a big disconnect between the building supply chain and the way that projects are specified. So, I am happy to give that a 4. Let me change that to a 3, because it is improving.

Interviewer: The interdependency amongst constructions stakeholders will slow down the transformation towards a sustainable industry.

Interviewee: Ah interesting one, I actually disagree with that because what happened is, what we have found is that in some cases where that interdependency has led to an exchange of information, and then there's actually been a greater awareness around transformation towards a sustainable industry. There are developers that choose to ignore information that is coming at them from the interdependence stakeholders. It is coming at them. I think it actually does the opposite, I think it has the potential to accelerate the transformation. Just not as fast as I'd like, so I disagree with that strongly. Probably about a one.

Interviewer: I am very interested in that because guys in the industry would say yeah, we agree with it but speaking to yourself and to others that are in the green area, they all disagree.

Interviewee: yeah, it's like it's like perhaps it is the thing that we identified as the resistance to change that is fueling that response, and they are saying no, no, no we don’t need that stuff coming at us. Whereas they are not reading the industry correctly because that independence. It is like having an interdependence on energy. Yeah, they're all independent on energy so the change in energy supply has an impact across the board. As soon as one person learns more about energy security or energy supply or energy management or whatever, it has an impact across all. I think we just choosing to take a

negative sentiment and transform it into a different response. But yeah interesting that you have come across that.

Interviewer: yeah and also a lot of them are saying that they haven't, they haven't, they don't have access to the reports. Where the reports are available, they don't necessarily read them. Not because they don't want to, but it's not really available and some of the reports are quite expensive to access.

Interviewee: have you found that in your research?

Interviewer: well I bought you report the Rands and Sense of Green Buildings that was but if I didn't know about it and uhm I didn't really have the drive to get that reports I wouldn't necessarily have come across it

Interviewee: yeah, there is a certain amount of awareness raising that we need to do?

Interviewer: I think that is coming out strongly in the in the findings OK but yeah once you get ahold of those reports and read through then they actually very insightful. OK, the knowledge of all players must be improved to ensure commitment implementation and participation in achieving sustainable construction.

Interviewee: strongly agree, 5.

Interviewer: the OK the incompatibility with other building components and higher requirements for materials handling and construction stage

Interviewee: I think I disagree with that, that's a two. I don't believe that there's an incompatibility between sustainable and conventional components. Not in, not in reality probably a perception now. You know what, I'm going to give it a 3. I mean the friend of mine is talking about a light steel frame project that he is involved in and how difficult it is to get the guys on site to assemble a thing correctly. I'll go with a three.

Interviewer: yeah, yeah. The lack of awareness and demand from end users of buildings due to the insufficient statistical research?

Interviewee: 4 I agree with that. Quite often people get a rolls Royce and they don’t realize it

Interviewer: yeah, The lack of a project management framework?

Interviewee: that's interesting is this for construction or operation of buildings?

Interviewer: Construction, construction.

Interviewee: I would agree with that. I don't think there is one.

Interviewer: I don't even know of one.

Interviewee: I think, I'll take a kick with that one and I'll take a hit on that one and say a five. I am not aware of one, not in South Africa anyway.

Interviewer: The unequal distribution of advantages amongst the developers and tenant or the extra cost incurred for green building cannot be passed onto a tenant readily

Interviewee: That's from lack of effort. It's entirely possible, I strongly disagree with that. Green leasing is entirely possible yeah yeah

Interviewer: you read my mind the potential that green leases can also be handed in the objective freight disrupt or burdensome to the tenant's primary operation especially if tenancy little incentive to increase the sustainability of the land owner's property assets.

Interviewee: that's a perception thing. You know the reality is that if the landlord wants to recover their investment, a green lease is part of that picture. I don't see why it would become burdensome to a tenant, when in fact the tenant benefits as well. So, the V&A Waterfront Shopping Centre is a prime example of a successful introduction to a whole bunch of multi-tenant spaces with some potential quite difficult lease agreements to renegotiate and I managed to be very successful. So, I strongly disagree. Just not widely understood I believe not widely utilized

Interviewer: OK, the relatively few sustainable construction sites that are engaged in in measuring energy flows in exchange

Interviewee: yeah, that's a problem we don't have any update play is the gradient and

Interviewer: the lack of top management support for adopting green procurement.

Interviewee: no, I think it's more about the translation from the top management to throughout the organization. Quite often there is a declaration C-suit level, there's a zero waste by 2020 plan, there's a this and that, but it is the actual implementation. It's a big issue. I disagree that it is an issue. So, I would say a 4.

Interviewer: disagree so that's a 2 or one?

Interviewee: that's a 2

Interviewer: the lack of environmental missions and strategies in real estate developer?

Interviewee: I agree with that. So, when we talk about top management support, automatically think about the corporate developers. When you talk about the real estate developer I think about the Developers. The developers will always say that the directive comes from the client and they just pass the buck and I think they say they don't get the directive but in fact they should be doing is anticipating the demand supply and so I think that that is correct. There is a lack of environmental mission. So, I agree and give it a 4. But not all of them are like that but the vast majority.

Interviewer: thanks all right OK, the lack of public interest and a willingness to pay a high entry cost to enjoy such privilege?

Interviewee: it is such a mixed bag. We have recently been doing some research on this and so it will be interesting to see what comes out of it. There's an obvious thing around reducing utility costs and most people want to reduce utility costs are willing to pay some capex in order to do that. But they are also willing to pay the capex to improve health and wellness so some of the softer issues. It is so dependent on levels of awareness.

Interviewer: and also, the generation because the millennials are kind of more interested in the green and the environmental side of things

Interviewee: I'm going to have to be neutral on this and go with a 3. such a mixed bag.

Interviewer: only well-established large firms have the ability, financial capital capacity to shift from the minimum standards a sustainable paradigm. Small and medium…

Interviewee: I strongly disagree with that, and the reason is: it depends on the level of innovation and thinking that goes into that. So, I would give it a one. There is a school in Jeppestown downtown Joburg on a shoestring budget they managed to get a green star interiors rates which is actually very difficult. But they were very smart about the way they went about that. You know they've gotten extremely low energy space because by virtue of the fact that they cannot afford a high utility bill and simply stripped out the you know the energy consumption. They really, you know brought it down. They used a whole bunch of reused and recycled building materials. Simply from a costing point of view it was cheaper and that meant that they also scored really well on the Green Star criteria. So, I think it's about the level of innovation and buy-in and will, rather than the size of the budget. There is you know the WWF building in Braamfontein is a six-star rated building. It was built at the same sort of price per square meters as an RDP house. It is not the normal, but it is possible.

Interviewer: so, yeah yeah and I think the more publish then people become aware of such success projects that will get adopted more readily. No, thanks Interviewee! Any other barriers that maybe I haven't mentioned that that you're aware of?

Interviewee: I would say I'm not sure if you if you feel that you have covered it but construction sector skills? Perhaps one of the limitations to conversion to alternative building technologies which are linked to more sustainable construction in some cases if they are properly applied.

Interviewer: any other barriers?

Interviewee: so, I think I think you've captured the majority of what I can think of.

Interviewer: OK thanks and then what strategies can be employed to promote sustainable construction to overcome the barriers? So, we spoke about skills in the construction sector. So, maybe that needs to

Interviewee: that's definitely one thing. So, skills transfer. So, government incentives. It is touched on in your survey, but I really, really do believe that incentives to introduce sustainable building frameworks will lead to a net financial benefit to the fiscus, yeah, so people using less energy means there is more energy in the grid for other purposes. People working, living, recreating in healthy indoor environments, have fewer health problems and are less of a burden on the health system. So, I think, incentives to bring about those types of built environments are absolutely critical to overcome the barrier. And then greater awareness which is our role. And a greater awareness of the costs to build green and the benefits to build green and sustainable built environments, is something that is desperately needed.

Interviewer: thanks, thanks very much for that and then in terms of the sustainable precincts Eric was mentioning that, pretty much like what happened with the Green Star rating it starts it out is a very low key rating tool but as time went on it now become almost commonplace that most new buildings are being green star rated. He was saying that, perhaps, with the sustainable precincts it's, it's going to be pretty much the same. It will start off very low key and progress and to try and get the process of getting the sustainable precincts rating tool better known and what's going to be required to get it more commonplace in South Africa.

Interviewee: so that would be the global trend and the local trend. So, what Eric says is probably correct if you think about the number of buildings in the country versus the number of

precincts for cities or neighborhoods, obviously the scale is different. So, the effort required to get buy-in to develop an urban development precinct is greater than the effort required to develop a sustainable building. So, given how difficult it is to do it building by building. I think it is going to be as bigger task to get to the point where urban precincts are considered relatively attainable and almost commonplace or similar to where we are with green buildings. Having said that, I think if we encounter the right triggers for example, it could be the right incentives or perhaps even legislation, we will see the kinds of transformation that Eric was talking about. Eric is a visionary, so I would say he probably is correct, I would align with that just to say that it may take a little longer, because of the scale that we are talking about.

Interviewer: OK thanks very much for your time really appreciate you setting this time aside. I know your time is at a premium but then I really appreciate it and once I've finished the research i was going to contact you and find out whether you want a copy of the research and uh with uh with I can also give you credits in my report.

Interviewee: Yes, that will be great we certainly would like to see a copy of the research and we actually now have a research and knowledge management function within the organization and if Alex wasn't away on leave, I would have directed you to her. She would be very keen to receive a copy of that and I'll sent off the consent form to you later

Interviewer: thanks, thanks very much Interviewee

Interviewee: and I am happy for you to reference the input that I have given.

Interviewer: thanks, thanks a lot

Interviewee: wish you all the best with your research. When are you due to submit?

Interviewer: I was hoping by the end of this month, giving the intention to submit. 1st you gotta give the intention to submit, my supervisor will have a look at it and then hopefully by October I'll actually submit the paper but

Interviewee: I know it is difficult, judging from your Whatsapp photograph you got a family So you have to juggle quite a few things so that is very impressive kudos to you for getting this far down the track, I know how difficult that is

Interviewer: thanks, going grey in the progress but but loving the research and what I'm finding.

Interviewee: awesome yeah thanks

Interviewer: Interviewee thanks so much and all the best with yourself as well

Interviewee: Hey thanks. Cheers Interviewer

Interviewer: Keep well Interviewee, cheers

Appendix F: Ethical Clearance

APPLICATION FORM

Please Note:
Any person planning to undertake research in the Faculty of Engineering and the Built Environment (EBE) at the University of Cape Town is required to complete this form before collecting or analysing data. The objective of submitting this application prior to embarking on research is to ensure that the highest ethical standards in research, conducted under the auspices of the EBE Faculty, are met. Please ensure that you have read, and understood the EBE Ethics in Research Handbook (available from the UCT EBE, Research Ethics website) prior to completing this application form: http://www.ebe.uct.ac.za/ebe/research/ethics1

APPLICANT'S DETAILS		
Name of principal researcher, student or external applicant		Dean Young
Department		Construction Economics and Management
Preferred email address of applicant:		yngdea001@myuct.ac.za
If Student	Your Degree: e.g., MSc, PhD, etc.	MSc. Property Studies
	Credit Value of Research: e.g., 60/120/180/360 etc.	60
	Name of Supervisor (if supervised):	Associate Professor Kathy Michell
If this is a researchcontract, indicate the source of funding/sponsorship		Self funding
Project Title		Enabling Sustainable Construction in the Real Estate Value Chain through Land Conversion Planning and Development Activities

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

- there is no apparent legal objection to the nature or the method of research; and
- the research will not compromise staff or students or the other responsibilities of the University;
- the stated objective will be achieved, and the findings will have a high degree of validity;
- limitations and alternative interpretations will be considered;
- the findings could be subject to peer review and publicly available; and
- I will comply with the conventions of copyright and avoid any practice that would constitute plagiarism.

SIGNED BY	Full name	Signature	Date
Principal Researcher/ Student/External applicant	Dean Young		24 Jan 2019

APPLICATION APPROVED BY	Full name	Signature	Date
Supervisor (where applicable)	Associate Professor Kathy Michell	K.A. Michell	25 Jan 2019 Click here to enter a date.
HOD (or delegated nominee) Final authority for all applicants who have answered NO to all questions in Section1; and for all Undergraduateresearch (including Honours)	Click here to enter text. NSEN-TSU TUAN		Click here to enter a date. 28 Jan 2019
Chair : Faculty EIR Committee For applicants other than undergraduate students who have answered YES to any of the above questions.			

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