

**GREEN PROCUREMENT AT THE DESIGN STAGE OF PROJECTS: A STUDY IN
SOUTH AFRICA**

by

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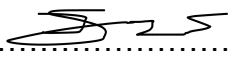
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Declaration

I, the undersigned, Ngwako Justice Malatji, student number 1558750, declare herein that the contents of this thesis represent my singlehanded effort and that sources cited or specified have been recognised through sound references. The thesis was never submitted earlier to another University and will not be tendered elsewhere for a related or similar degree.

Signature.....

NJ Malatji

Date: 02/02/2021

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I thank God, the almighty, for making my academic dreams possible when there was no sign of light, due to the many challenges encountered during my studies. Lord, you provided me with strength after the sudden departure of my wife; you lifted me up when I was down in order to resume my research project.

God, you made it possible for family members, friends, neighbours, church brethren and colleagues to provide immense solace during our time of grief. Their support is highly appreciated. A synagogue would be an appropriate place to thank you, indeed.

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Dedication

To my late wife, Mabusha Petunia Malatji, who passed away on 22nd of February and was laid to rest on 3 March 2018. This journey was not easy in your absence. Rest in peace, my angel.

Abstract

The construction industry has a substantial impact on the environment, especially new constructions, which consume immense quantities of non-renewable resources. Green procurement is currently a subject of global interest, being capable of providing solutions to a variety of concerns around environmental degradation. There is a need to apply green procurement (GP) at the design stage of construction projects; to improve a building's sustainability performance since the chances of project optimisation is greater if such concerns are incorporated early. The study investigated the extent of green procurement practice by designers, in particular engineers and architects, at the design stage of construction projects within the public sector. The study adopted a deductive, quantitative approach, with a literature review preceding data collection. The literature review enabled a broad exploration of current thinking on green procurement at the design phase of projects and laid a good foundation for crafting of the research problem and research question. This exploratory study embraced a mono method quantitative approach for data collection using a questionnaire, and corresponding quantitative analytical procedure for data analysis. Non-probability sampling was applied to select the right participants as representatives for the entire population. From the responses received, it was clear that green procurement legislation, regulations and policies exist and are acknowledged by the Department of Public Works, and are sometimes practised during the design stage of construction projects. However, compliance with the legislation and policies is generally low; whereas the literature upholds legislation, regulations and policies as drivers of green procurement, the findings in this study are that decisions in this regard lie with the individual client. There is a general disregard for green procurement criteria during the tender or quotation stages when sourcing external consultants, and a lack of knowledge amongst key stakeholders that may result in a gradual or poor implementation, and resultant environmental degradation. More capacity building and awareness is needed, amongst both the client and the designers, so that green procurement projects may be fully implemented by the Department, for the benefit of the natural environment.

Keywords: Green procurement, green supply chain management, design stage of projects, sustainable design of projects and green government procurement.

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List of acronyms

DEA	: Department of Environmental Affairs
DOE	: Department of Energy
DEFRA	: Department of Environment, Food and Rural Affairs
DPW	: Department of Public Works
EIA	: Environmental Impact Assessment
GGP	: Green Government Procurement
GHG	: Greenhouse Gas
GPP	: Green Public Procurement
GP	: Green Procurement
GSCM	: Green Supply Chain Management
ICLEI	: International Council for Local Environmental Initiatives
IISD	: International Institute for Sustainable Development
NA	: National Assembly
NCOP	: National Council of Provinces
NDPW	: National Department of Public Works
OECD	: Organisation of Economic Corporation and Development
PFMA	: Public Finance Management Act
PMS	: Project Management Schedule
South Africa	: Republic of South Africa
SACPCMP	: The South African Council for the Project and Construction Management Professions
SSCM	: Sustainable Supply Chain Management
WSSD	: World Summit on Sustainable Development

Definitions of terms

In this section, terms significant to the study are defined, as derived from the literature review.

Green is defined by Bohari, Skitmore, Xia and Teo (2017) as an acceptance of conservation approaches, and the integration and application of such approaches during projects, as well as efforts made to diminish the ecological impression of projects throughout their lifetime.

Green sourcing means collaborating with suppliers to buy materials with a high degree of recycled content, the avoidance of greenhouse gasses, and overall energy efficiency (Moronge & Zawadi, 2018). A green product or service has a lower environmental footprint than a comparable product or service. 'Environmental footprint' refers to the general impact of an activity on the surroundings, including its use of water and energy, and its impact on human wellbeing and other dimensions of the social setting (Bohari et al., 2017).

Green Supply Chain Management (GSCM) is defined by Niemann, Kotze & Adamo, (2016) as an approach to supply chain management that uses sustainable supply chain inputs, and that changes similar inputs to make them capable of being used more than once, thereby making a 'green' supply chain.

Legislation refers to laws enacted by parliament (Collins Dictionary, 2020).

Public policy means a planned course of action of government, or procedures that are pursued in order to achieve certain goals and objectives; public policy is always dependent on environmental change (Roux, 2002).

Recycling is the practice of making disposable material returnable through new assembling or reprocessing for the manufacture of brand-new products (Bhardwaj, 2016).

Regulations are rules made by a government or other authority in order to control the way something is done or the way people behave (Collins Dictionary, 2020).

CHAPTER ONE: INTRODUCTION AND BACKGROUND TO THE STUDY

1.1 Introduction

Green procurement (GP) is currently a subject of global interest both in developing nations and in academic circles. Green procurement is the procuring of services and supplies that have a minimal negative effect on the environment and on societal wellbeing, and may even have a constructive effect, when compared with a services or products serving similar purposes (Urban Seed, 2012). Muraguri, Waweru and Musyimi (2015) define green procurement as the procuring of services or products that have minimal effect on the ecosystem throughout their entire lifespan. Authors define green procurement differently but there is general agreement on overall meaning.

It is a crucial aspect of modern business practice, introduced due to concerns about environmental degradation and climate change, and is ratified by the United Nations Framework Convention on Climate Change (UNFCCC). Balasubramanian and Shukla (2017) state that climate change and environmental pollution have emerged as one of the biggest challenges to companies and governments, compelling both to evaluate the ecological impacts of their actions. Climate change is by now a noticeable phenomenon, affecting most aspects of life in developing nations, including South Africa (DEA, 2011). Agyepong and Nhamo (2015) state that South Africa has experienced the danger of broad ecological deterioration and is resolute in reacting to the challenges of climate change.

Dadhich, Genovese, Kumar and Acquaye (2014) point out that globally, businesses are increasingly stressed by anxiety over escalating climate change, carbon emissions, waste generation and scarcity of resources. Most resources emanate from the environment in which we live, driving businesses to examine their procurement practices simply to ensure the sustained supply of essential goods. Society in general depends on the environment for daily needs and services; we would hardly survive if the environment degraded beyond a certain point – which, if certain practices are maintained, seems precariously close to happening.

The slow deterioration of the global natural environment has been stressed in numerous key environmental conferences (Bohari et al., 2017). The construction industry has been roundly condemned for its adverse impacts on ecosystems due to its exorbitant energy use, its discharge of greenhouse gasses and general waste generation (Wyawahare & Udawatta, 2017; Yu, Javed, Lam, Shen & Sun, 2018 ; Vink, Abdalla, Favié, Huyghe & Maas, n.d). Human expansion on the planet has largely disregarded the balance of natural elements and general environmental concerns (Emuze, Ntoi & Isa, 2015). This disregard causes countless undesirable repercussions to surroundings and to the quality of life of all living things, including humans (Mewomo, Aigbavboa & Thobakgale, 2017).

A seminal acknowledgement of the environmental challenges created by human expansion was made in the 1987 Brundtland Report, which proposed limits to expansion along with the introduction of sustainability measures for proper resource management (Bohari et al., 2017; Vink et al., n.d.). It aimed to decrease resource deterioration and reduce pollution for the preservation of natural systems for coming generations.

Following the United Nations Framework Convention on Climate Change (UNFCCC) in 1992, international efforts have been made to address environmental challenges, including among members of the Organisation for Economic Co-operation and Development (OECD). Agyepong and Nhamo (2016) assert that among the aims of OECD are to confront the sustainability concerns of globalisation in the economic environmental, and social spheres. They further state that an OECD environmental policy committee formed in 2002 crafted green procurement propositions relating to services and products, which are recommended for all member nations.

In addition, several important conferences have been convened, particularly with respect of the World Summit on Sustainable Development (WSSD) and the United Nations Framework Convention on Climate Change (UNFCCC), which in turn resulted in the Kyoto protocol, setting emissions targets for signatory countries. The WSSD was held in South Africa in 2002 and proposed various green public procurement practices with the aim of addressing climate change (Agyepong & Nhamo, 2016). South Africa needs to balance its huge demand for socioeconomic expansion with safeguards for the natural environment (Nyamazana & Ozumba, 2017). This is not an

easy task; for instance, the environmentally necessary task of transforming RSA's power provision from coal to renewable energy has direct negative impacts on jobs, raising the spectre of massive unemployment. As a result of this danger, unions in South Africa threatened to take the government to court in 2018 over the signing of agreements with independent power producers.

Green procurement in South Africa was introduced through the National Climate Change Response White Paper of 2011, steered by South Africa's Constitution, the Bill of Rights, the National Environmental Management Act, the Millennium Declaration and the United Nations Framework Convention on Climate Change. Domestic instruments meant to address environmental degradation include the Constitution of the Republic of South Africa, Section 24 of Act 108 of 1996, which relates to protecting the environment. Relevant policies or Acts introduced in South Africa include the Carbon Tax Act No 15 of 2019, the Plastic Bag Levy, the National Climate Change Response White Paper of 2011, and the White Paper on the Promotion of Renewable Energy and Clean Energy Development (2002).

Recent environmental projects that have been strongly influenced by domestic instruments such as the above include the Bus Rapid Transport (BRT) system implemented by the Cities of Tshwane, Johannesburg and Cape Town.

1.2 Background to the research

Sustainable procurement cannot be omitted from the discourse on green procurement as the two are closely related (Agyepong & Nhamo, 2016). Omusebe, Iravo, Ismail, and Wanjohi (2017) assert that green procurement is also known as the sustainable procurement. Various authors define sustainable procurement differently; the essence, however, is that sustainable procurement aims at achieving business goals while protecting the environment.

Ruparathna and Hewage (2015) define sustainable procurement as a process by which corporations obtain their necessities by works, goods, utilities and services that accomplish optimal price-performance ratio throughout the natural life of the product or service, yielding paybacks not just to the corporation, but to the general public and the economy while strongly limiting destruction of the natural environment. Muraguri

et al., (2015) define sustainable procurement as ethically and socially sensible procurement, and a reduction of ecological effects via the supply chain to provide efficient solutions to problems and sound business-related practices. Agyepong and Nhamo (2016) concurs that sustainable procurement is purchasing that ensures 'a solid, healthy and just society living within environmental limits and encouraging good governance.

Muraguri et al., (2015) assert that green procurement is based on pollution deterrence and aims to lower hazards to the atmosphere and to social wellbeing. The objectives of green procurement and sustainable procurement are similar; to protect the environment and human health through sound decisions when products or services are procured. Efforts should be made to procure a range of goods with services that have minimum effects on ecosystems and public health (Agyepong & Nhamo, 2015).

Jia, Zuluaga-Cardona, Bailey and Rueda (2018) aver that in general, efforts to promote rapid economic advancement and poverty relief take priority over environmental safeguarding. Hence substantial physical developments occur in various developing countries to provide much-sought-after services such as infrastructure and shelter, which subsequently result in a multitude of environmental difficulties such as interior and exterior ecological pollution (Bohari et al., 2017; Othman & Abdelwahab, 2018). Abbasi (2017) states that supply chain actions can have unfavourable effects on communities, and that strenuous efforts need to be made to reduce these. Aspects to bear in mind when procuring products and services would include the effect on health and safety, congestion, noise, likelihood of accidents, land take and degeneration of the cultural carrying capacity of an area, among others.

Supply chain cannot exist without natural resources. Properly conducted supply chain management can, however, make a substantial contribution towards sustainable development in that newly developed areas can be designed in such a way that satisfies community social needs, provides much-needed amenities, and, of course, reduces unemployment (Abbasi, 2017). From a review of the literature, current supply chain practices in South Africa seem to contain both constructive, favourable elements and damaging, unfavourable elements.

Many studies confirm that the building industry has substantial negative impacts on the environment, especially new constructions, which consume massive quantities of

non-renewable resources and materials. For example, the manufacturing and transportation of construction materials require a huge amount of energy, generating emissions of greenhouse gasses (Wong, Chan & Wadu, 2016; Ismail, Halog & Smith, 2017). Many researchers state that the building industry remains the dominant utiliser of raw materials and is the main cause of environmental pollution, with vast amounts of energy used during the fabrication of building materials, the erection period, and the use of finished buildings in terms of heating, lighting, power and ventilation (Yu et al., 2018; Othman & Abdelwahab, 2018; Akadiri, Chinyio, Olomolaiye, 2012). Another impact is that of building rubble, which, if not properly disposed of during and after completion of the project, results in unsightly dumping as well as waste running into rivers, which is detrimental to humans, animals and land. In addition, Ismail et al., (2017) affirm that much damage is caused when floods affect garbage dump sites, causing garbage to clog storm water drainage systems and rivers, escalating external overflow and augmenting the topmost torrent during flooding – thus exacerbating the effects of floods in built-up areas.

Yu et al., (2018) advocate that the building sector be restructured through the implementation of innovative, efficient, sustainable building procedures. It is significant to introduce sustainability as a concept and a practice at the inception of building projects in order to broaden awareness of the various options available to clients, designers and contractors. Isa, Emuze, Das and Awuzie (2018) concur that the construction sector has to shift the focus when creating immovable structures and take on more cyclical approaches, incorporating reprocessing, revitalisation and the reclamation of resources, rather than opting for fresh excavation of natural resources and massive outpourings of energy. Jia et al., (2018) state that environmental initiatives consist of moves in the direction of green procuring, the use of environmentally friendly products, resource efficiency, proper handling of debris, inverse supply chain and the promotion of environmental compatibility through appropriately designed functions. In view of its potential to damage the environment and thus impoverish communities over the long term, it is crucial that the public sector acknowledges the solutions presented by green procurement and join the fight against environmental degradation. This needs to be done at the very inception of projects, and not as an afterthought.

1.3 Derivation of the research problem

From the discussion in the background, there is a need to apply green procurement (GP) at the design stage of construction projects so as to save time, cost and most importantly the resources for use by the next generation. Previous studies on this topic have focused on sustainable procurement and sustainable construction practices; being the aspects of a project life cycle; there is no sufficient information particularly on design stage. Ruparathna and Hewage (2015) carried out a study to review sustainable procurement practices in the Canadian construction industry. Oke, Aghimien, Aigbavboa and Musenga (2019) assessed the sustainable construction practices in the Zambian Construction Industry. The lifecycle phases of a project differ in terms of organization, industries (Burger, 2013) and countries. Burger (2013) aver that SACPCMP's project work stages for a typical construction project are; project initiation and briefing, concept and feasibility, design development, tender documentation and procurement, construction documentation and management, and project close out.

In the context of South Africa, the practice is little known even though Green Building Council exist. There are no general practices especially in the public sector, however the private sector is at advanced stage. The public sector in South Africa is a dominant client as well as initiator of projects and that one might reasonably expect alignment between national legislation and NDPW practice. There is not enough literature investigating the extent of GP practice at the design stage in the public sector. Few studies have been undertaken to examine green procurement at the design stage of construction projects, as pointed out by Balasubramanian and Shukla (2017). Some studies avow that improving a building's sustainability performance ought to start during the design stage, since the chances of project optimisation is greater if such concerns are incorporated early (Braganca, Vieira, & Andrade, 2014). Such practice would eliminate the occurrence of variations in design and construction at later stages, and so help in controlling costs down. The design development phase affords a meaningful opportunity to encompass eco-friendly standards within construction procurement and can be used to accomplish resource effectiveness, energy efficiency and use of environment-friendly materials and practices. (Othman & Abdelwahab, 2017; Kiggundu, 2014). In the absence of literature, the gap only creates more room

for GP practices at the design stage of projects in the public sector so as to know factors inhibiting.

Based on the foregoing, the research problem can be stated as in section 1.4.

1.4 Statement of the research problem

Based on the foregoing, the research problem can be stated as:

There is limited application of green procurement by designers, in particular engineers and architects, at the design stage of construction projects within the public sector.

1.5 Research question

This study investigates the following question:

To what extent is green procurement practised by designers, in particular engineers and architects, at the design stage of construction projects within the public sector.

1.6 Research aim and objectives

The study aims to investigate the extent of green procurement practice by designers, in particular engineers and architects, at the design stage of construction projects within the public sector.

Three objectives emerged that are consistent with the stated aim:

- (a) To identify policies, legislation and regulations enabling the practice of green procurement at the design stage of projects in the public sector.
- (b) To find out the extent to which designers practise green procurement at the design stage of projects in the public sector.
- (c) To investigate barriers, if any, associated with practising green procurement by architects and other designers at the design stage of projects in the public sector.

1.7 Research assumptions

The key assumption for the study is that there is a measure of GP practice among designers at the design stage of construction projects in the public sector, South Africa as affirmed by amendments to the building regulations in 2011 which culminated in to retrofitting of public buildings with water and energy efficiency technologies.

1.8 Scope of research

The study is about green procurement practice at the design stage of construction projects in the public sector. The research explored how green procurement is practised by architects and engineers (designers) at the design stage of construction projects in the public sector, with a particular focus on the National Department of Public Works (South Africa); as it is likely to have the necessary competencies and influence on Provinces and Municipalities. The National Department of Public Works comprises eleven (11) regional offices across nine provinces in South Africa. However, this study covered only the Johannesburg, Nelspruit and Polokwane regional offices, in addition to the Head Office in Pretoria.

The study's population comprised of built environment architects and engineers registered with the South African Council for the Architectural Profession (SACAP) and the Engineering Council of South Africa (ECSA) who perform work at the design stage of construction projects. In more detail, the population includes designers such as architects, civil, structural, electrical and mechanical engineers' who are external private consultants and not employees of NDPW. These professionals are capable of influencing projects with regard to sustainability issues at the design stage. The designers who participated were all external consultants appointed through a tender, quotation process or roster database of pre-approved professional service providers executing works at the design stage of projects.

1.9 Overview of the study's content

This study consists of six logically arranged chapters, structured as follows:

Chapter 1: Background and introduction

Chapter 1 provides the introduction and background of the study, the derivation of the research problem, statement of the research problem, research question, and the research aim and objectives, concluding with the research assumptions and the scope of the research.

Chapter 2: Literature review

Chapter 2 reviews previous and current literature on green procurement practices internationally, with information arranged according to continents and countries, followed by a discussion on the same as practised in South Africa. Key objectives of this chapter are to gain and present an overview of the topic, to identify research gaps, and to establish the drivers and barriers of green procurement practice.

Chapter 3: Research design and methods

Chapter 3 explains the research design and methods used for data collection and analysis so as to address the research question and realize the research aims and objectives. The study adopted a deductive (top down, or general to specific) approach wherein the literature review preceded data collection and was correlated with quantitative research.

Chapter 4: Constraints on data collection, data presentation, analysis and results

Chapter 4 demonstrates the constraints encountered during data collection, presents the data and analyses the results.

Chapter 5: Discussion of results

Chapter 5 discusses the results of the study and draws conclusions.

Chapter 6: Recommendations

The final chapter examines the conclusions to presents recommendations based on the findings.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This section of the study presents an outline of the topic of green procurement as presented in published studies. Sources included academic journals, articles, government publications and newsletters. An extensive literature search for academic journals was undertaken through renowned databases such as Science Direct, Google Scholar, Emerald Insight, ResearchGate, Taylor & Francis and Elsevier, using the following keywords: green procurement, green supply chain management (GSCM), green design of projects, sustainable design of projects, sustainable procurement, green government procurement, green supply chain management, barriers of green procurement and drivers of green procurement.

The literature review assisted in shaping and refining the research problem so as to determine the research objective. This study intends to determine how green procurement is practised by built environment designers such as architects and engineers at the design stage of construction projects, using the National Department of Public Works as context. It examines the enablers or drivers as well as the barriers associated with practising GP. In the research, the drivers of GP are examined separately from the implementation of green procurement. Therefore, it was important to identify through the literature, the policies, legislation and regulations that enable green procurement.

This chapter examines the findings on the practice of GP both globally and in South Africa, and examines the drivers or enablers and the barriers of green procurement.

The first section presents an outline of green procurement as managed and practised internationally.

2.2 Green procurement practice

2.2.1 Green procurement practice internationally

The world's land mass comprises of seven continents: Europe, Asia, North America, Oceania (Australia and New Zealand), South America, Antarctica and Africa. This

study reflects on green procurement on all except Antarctica where it is not applicable. Table 2.1 show summary of international GP practices.

2.2.1.1 Europe

Public authorities across Europe have been practising green procurement for a number of years, and a recent study suggests that roughly half include green public procurement criteria in their tenders regularly (Muraguri et al., 2015). Numerous scholars have revealed that European countries are leaders in green procurement, with the European Union having promoted the concept since 1992 (Geng & Doberstein, 2007). According to Moronge and Zawadi (2018), a number of areas exist wherein European Union laws or country-specific national laws establish specific environmental obligations for public procurement. These include the legal requirement to conduct an environmental impact assessment prior to certain construction developments. Table 2.1 show summary of international GP practices.

a) The United Kingdom (UK)

The UK has been practising green procurement for many years. Yu et al., (2018) state that sustainability concerns are routinely taken into account in most construction projects; an example is the green residential project in Crianlarich, Scotland (UK). According to Bohari et al., (2017), the UK government has introduced a rating tool called the Building Research Establishment Environmental Assessment Method (BREEAM) in an effort to support sustainability. Higham, Barlow, Bichard and Richards (2018) state that in the UK, the idea of sustainability extends beyond environmental sustainability and includes economic and social aspects of development. Sourani and Sohail (2011) state that the triple bottom line of sustainability – environment, economy and people – continues to be dominant in the UK building sector.

A study by Chowdhury, Upadhyay, Austin and Belal (n.d) concurs that developed or technologically advanced countries like the UK have instituted GSCM practices in the building sectoral. Around July 2008, the British government teamed up with parties in the industrial sectors to introduce strategies for green construction. The project, co-ordinated by the Department for Environment, Food and Rural Affairs (DEFRA), identified plasterboard as among the ten most damaging and concerning commodities

in the agenda for environmentally-friendly production and consumption (Dadhich et al., 2014). The authors affirm that the DEFRA strategy aims to promote safe and sound management, nil wastage at dumping grounds, efficient manufacturing and sustained partnering. The UK government has established a firm goal of diminishing its total carbon discharge by 50% by 2025. In aiming for a low-level carbon economy, the UK government now requires each firm registered with the London Stock Exchange to give an account of their carbon footprint in their annual reports.

The UK government is also dedicated to economic restructuring, since it is determined to recuperate from recession. It is confident that mainstreaming green expansion policies will result in sustained development, economic prosperity and improved quality of life (Dadhich et al., 2014).

Ahsan and Rahman (2017) aver that the UK government has played a dominant role in ensuring green public procurement (GPP) through legislation, stating that numerous government reports published in the UK appeal to public clients to attend to sustainable construction in their purchasing strategies. Ofori (n.d) concurs that the British government has integrated environmentally safe purchasing across all services including goods, following the national strategic framework for achieving sustainability, outlined in a document entitled *Securing the Future*. An increased emphasis on sustainable purchasing has been shown in official reports published in the UK (Sourani & Sohail, 2011).

The literature affirms GP practice by the UK authorities and the private sector, which has been mainly facilitated by a paradigm shift with regard to legislation.

b) Denmark

In 1994, Denmark introduced a tax on plastic bags in an effort to combat environmental degradation which consequently lead to a 66% reduction in their use (Dikgang, Leiman & Visser, 2012). A study by Geng and Doberstein (2007) affirmed the rise of green government procurement (GGP) in all industrialised economies including Denmark, which is now able to boast that more than 40% of everything purchased by the State follows ecological principles – at least to 50% for the individual product or service (Moronge & Zawadi, 2018; Muraguri et al., 2015). A study by Da Silva, Betiol, Villac,

Nonato (2018) points out that government organisations in Denmark have possessed a compulsory adherence standard for green public purchasing from 1994.

c) Sweden

The rise of GGP in developed countries is affirmed in a study by Geng and Doberstein (2007) who include Sweden in the list of countries which now uphold a policy that at least 40% of all government purchases are green. In fact, recent, recent studies show that in Sweden, around 50% of government purchasing activities are for products and services that follow green principles beyond 50% (Moronge & Zawadi, 2018; Muraguri et al., 2015). Da Silva et al. (201,8) affirm that in Sweden, sustainable procurement has been seriously discussed since 1990. Green procurement has risen steadily since 2007.

d) Germany

Geng and Doberstein (2007) state that green government procurement (GGP) practices resulted initially and most completely in countries of the OECD. Germany is a leading member of OECD and has practised GGP guiding principles for nearly 20 years. A study by Da Silva et al., (2018) maintains that in 1986, Germany was the first country to introduce sustainable or green public purchasing policy, trailed by Austria, Denmark, the Netherlands and Sweden. The authors further state that Germany established a government green label named 'Blue Angel', as early as the 1970s, to indicate products that met certain environmental criteria.

The German government partners with the private sector on aspects of green procurement. A study by Agyepong and Nhamo (2015) reports on the success of an energy saving joint public/private venture in Berlin, the biggest city in Germany, wherein an energy-saving firm was appointed for the development of the best and most appropriate energy saving scheme for government. This partnership between the private sector and government shows the level of seriousness with which the German government regards green issues. Berlin has engaged in major upgrades and the refurbishment of hardware components along green lines, including the use of automated engineering methods, and appropriate lighting, heating, air-conditioning

control and ventilation systems, for which retrofits in public and commercial buildings are common (Agyepong & Nhamo, 2015).

e) *Italy*

Italy is another European country involved in the safeguarding of the environment through green procurement. A five-euro-cent levy on the fabrication of plastic bags was proclaimed in Italy in 1989 (Dikgang et al., 2012), making plastic bags more costly than alternatives such as paper bags. According to Ahsan and Rahman (2017), a government directive in Italy compels government to ensure that a minimum of 30% of goods bought by government conform with environmental standards. Testa, Annunziata, Iraldo and Frey (2014) state that the Italian government, which purchased services as well as goods worth 95.3 billion EUR in 2012, has so far developed remarkably through its acceptance of GPP, yet has potential to improve and expand in this area. According to Agyepong and Nhamo (2015), Venice in Italy has initiated an integrated mobility plan comprising various sustainable projects with the objective of slashing carbon emission in the transportation zone by 35%. The authors further state that tram lanes have been erected, bike lanes marked out, electric vehicle charging stations constructed, vehicle sharing arrangements established and parking and riding amenities created to allow individuals to leave their own vehicles at home and make use of bus, trams and cycling.

The practice of green procurement in the European continent has focused on leaders in this area – the United Kingdom (UK), Denmark, Sweden, Germany and Italy.

Asia is the next continent to be explored.

2.2.1.2 Asia

Asian countries involved in the practice of green procurement include Singapore, China and Hong Kong, Japan, Malaysia and the United Arab Emirates, as depicted in Table 2.1 below.

a) Singapore

Genga and Doberstein (2007) aver that by the mid-1990s, environmental innovation ideas such as GGP had started to gain traction in unindustrialised nations, specifically in East and Southeast Asia where states progressed swiftly through industrialisation, aided by political revolutions. The authors avow that modern environmental approaches began in Singapore, South Korea and Taiwan, deemed the 'Asian tigers', and extended quickly to more recently advancing countries such as Malaysia, Thailand and China.

Bohari et al. (2017) state that Singapore is a developed state and the status of green procurement practice in the country is advanced, to the extent that they carry out green fabrication as well as procuring. Numerous regulations have been launched in Singapore to control construction so as to decrease the construction sector's environmental impact. The country has introduced a rating tool known as the Green Mark (Bohari et al., 2017) in an effort to safeguard the environmental and Ofori (n.d) attests that the Building and Construction Authority (BCA) initiated the Green Mark Scheme within the construction sector effective January 2005. The aspiration has been 'to shift Singapore's construction along with building sectoral in the direction of environmentally friendly buildings and facilitate reinforcing the country's status as an international city dedicated to balance their expansion alongside environmental consideration' (Ofori, n.d, p. 382).

Ofori (n.d) researched the issue of sustainability in construction-related procurement in Singapore. The author found that guidelines for green purchasing and other activities are contained in the National Green Plan, first published in 1992 and updated regularly. Singapore's Green Plan 2012 (2006 edition) was crafted through collaboration with over 17 000 people and provides a ten-year strategy for several key areas: (a) public health, (b) nature, (c) air and climate change, (d) intercontinental ecological interactions, (e) water and (f) waste management. Singapore is land constrained and as a result has a single landfill site; it burn up around 90% of its waste.

b) China and Hong Kong

Moronge and Zawadi (2018) state that the Chinese government has been using green procurement since 2004 to safeguard the environment. However, Wong et al., (2016) point out that the practice of GP in Hong Kong is by far not at all compulsory – government has called on industry to undertake green procurement and clean construction in their activities, but there are no penalties for not doing so. Chowdhury et al., (n.d) state that developed and technologically advanced countries like China have instituted GSCM practices in the building industry. Bamgbade and Babatunde (2017) refer to the Green Construction Guideline published by China's Ministry of Construction (MOC) in 2007. According to Yu et al., (2018), all structures in Hong Kong face north in order to take advantage of natural light thus save on electricity. These authors assert that recently in Hong Kong (now part of China), ten 'jumbo' or 'mega' public service projects proclaimed during a policy address of 2007–2008 are currently being implemented, amounting to HK\$49.6bn (US\$6.39bn), all of which prioritise environmental sustainability. For instance, greening and inner-city linkages are stressed in the Kai Tak revitalisation project.

The literature affirms that green procurement has been made possible in China and Hong Kong by government legislation. Kahanaali, Khaksar & Abbaslu (2015) state that regulatory enforcements influenced China's auto industry to adopt green supply chain approaches, a significant achievement. China has instituted several environmental laws; for instance, the Pollution Prevention Law, the Environmental Protection Law, the Renewable Energy Law and the Cleaner Production Promotion Law (Kiggundu, 2014). Wong et al., (2016) aver that the Hong Kong administration has announced numerous policy actions in recent years aimed at accomplishing green expansion and a lower-carbon lifestyle. One such notable policy applies to the building sector, and urges government departments to reflect ecofriendly choices when acquiring goods and services.

c) Japan

The literature shows that in Japan, a non-profit organisation called Green Purchasing Network (GPN) was established in 1996 with the objective of spreading the green

procuring concept and providing information on practising green purchasing (Ahsan & Rahman, 2017; Moronge & Zawadi, 2018).

Agyepong and Nhamo (2015) state that Japan is amongst the leading nation states to have instituted eco-labelling in 1989, and passed the Green Purchasing Law in 2001, requiring all state institutions to carry out green procurement and report on it in their annual reports. Public institutions are compelled to buy designated services and products considered ecologically sound (Agyepong & Nhamo, 2015). Furthermore, it is mandatory in Japan that new constructions of large buildings comply with environmentally friendly standards and that they pass a performance rating in terms of cost-effective power usage, proper resource usage, mitigation of heat-island effect and the conservation of the natural environment (Agyepong & Nhamo, 2015).

Tokyo engages in green practices, including the use of reclaimed waste water and the implementation of green building programmes (Agyepong & Nhamo, 2015). The authors affirm that waste water collected from sewer lines is treated and cleansed by means of sedimentation, coagulation and the use of ceramic filters for sieving. The recycled water is piped to consumers using subterranean piping for use in lavatories in workplaces and the watering of street plants.

d) Malaysia

Construction practitioners in Malaysia are urged by government to apply greener approaches, as the country plans for numerous building projects to provide for its recent and forthcoming expansion (Bohari & Xia, 2015). Bohari et al., (2017) state that Malaysia's green procurement focusses mostly on environmental impacts, and the building sector has been responsive, striving to purchase green goods and services wherever possible. Nevertheless, a balance is required to incorporate other areas of the triple bottom line, i.e., society and the economy.

Bohari et al., (2017) assert that there are no particular guidelines for GP practices in Malaysia's construction and building sector, and that the said practice is blurred and disjointed. However, a study by Chowdhury et al., (n.d) states that developed and technologically advanced countries like Malaysia have instituted GSCM practices in the building industry. It is unfortunately not known when the study by Chowdhury et al.

(n.d) was conducted; such information would allow one to compare the established GSCM practices with the finding of Bohari et al., (2017). Research by Bohari and Xia (2015) indicates that green procurement in Malaysia is still in its early stages, with a lack of knowledge and no step-by-step guidelines for stakeholders that might enable designers and contractors to implement environmentally friendly construction projects. Bohari et al., (2017) state that some measures are in place to urge both the private and government sectors to embrace green procurement; for example, there is an environmental classification system and 'Green Provider' register, generated by the Ministry of Energy, Green Technology and Water (KeTTHA) in 2012.

The literature affirms that green procurement is practised in Malaysia, albeit at a fairly basic level with room for improvement.

(e) The United Arab Emirates (UAE)

Athapaththu and Karunasena (2018) state that the United Arab Emirates (UAE) administration has ammended its construction regulations to promote sustainability in the building sector. As part of the strategic vision of the ruler of Dubai, green building regulations and specifications were made compusory for the construction sector in the Emirate of Dubai as a move to safeguard the surroundings without sacrificing socio-economic concerns.

Balasubramanian and Shukla (2017) point out that the United Arab Emirates (UAE) has undergone extraordinary growth in the building sector, growing by over 9% annually in recent years. Recent large building projects constructed in the UAE include the Burj Khalifa, the highest structure in the UAE, the JW Marriott Marquis (the tallest hotel) and the Dubai Mall. The authors state that the implementation of green approaches in these huge construction projects pushed the UAE to eighth position amongst countries listed by the American organisation, Leadership in Energy and Environmental Design (LEED). In addition, these projects created jobs in the provision of green goods and servcies. Green practices in these projects have reduced the UAE's carbon footmark per person from 23 metric tons per year in 2008 to 20.4 in 2011. Despite this reduction, the UAE remains one of the biggest carbon producers in terms of per capita carbon foorprint (ibid). There is much potential to improve in this country in light of overall carbon emissions and the practice of green procurement.

Green procurement practice has been outlined for Asia with specific reference to Singapore, China and Hong Kong, Japan, Malaysia and the United Arab Emirates. North America is considered next.

2.2.1.3 North America

Both the United States of America and Canada are committed to environmental protection through green procurement. Table 2.1 show summary of international GP initiatives practiced by the United States of America and Canada.

a) United States

Geng and Doberstein (2007) affirm that GGP requirements have been in force in United States metropolitan, state, and national public institutions since 1993, and have increased in recent years. Chowdhury et al., (n.d) confirm that technologically advanced countries like the USA and Canada have implemented GSCM practices in the building industry and extended such practices to other areas such as transportation.

Patel and Giordano (2014) argue that Environmental Impact Assessments (EIAs) were first introduced in the United States in 1969 and thereafter were extended to other countries. EIA stands for Environmental Impact Assessment, conducted before the start of development activities to evaluate the environmental effects of such activities. The EIA determines whether a project or activity will adversely affect the environment, and if so, what justifies the project and what measures will be taken to mitigate impact (Patel & Giordano, 2014).

Dubey, Gunasekaran and Papadopoulos (2017) state that despite the environmental consciousness which swept the USA in the 1960s and radiated out across the world, countries such as China and India have been slow to respond to the environmental call. Leadership in Energy and Environmental Design – LEED – is a global ‘green’ rating instrument initiated in the United States of America (Bohari et al., 2017) in support of a global awareness of sustainability issues.

Within the US, individual cities vary in their responsiveness to the environmental crisis. San Francisco switched its metropolitan or town fleets to electronic and hybrid automobiles to reduce carbon emissions (Agyepong & Nhamo, 2015). It has increased its usage of zero- to low-emission buses, replaced traditional diesel buses with those that require minimal repairs and generate a fraction of the pollution of ordinary buses, and retrofitted the existing fleet with accessible technologies using low-carbon fuels. Philadelphia has implemented solar energy in certain public facilities to reduce carbon emissions, with 250-KW solar panels covering an acre of ground at a certain water purification plant. Annually, the solar panels produce around 300 000KWh of energy capable of powering 28 homes. Thus, obviates the need for coal-based power and could be implemented on a much greater scale.

b) Canada

Geng and Doberstein (2007) state that the Canadian administration published *Directions on Greening Government Operations* in 1995, a document that identifies green government procurement as a primary means of protecting the natural environment. Thereafter, in 1998, Canada enacted the Sustainable Development Act and instituted a green reporting framework (Ahsan & Rahman, 2017).

Wessels (n.d.) states that Canada lists over 650 environmentally responsible materials in the Canadian Federal Government's National Master Specification (NMS). The author further states that Environment Canada has established EcoNexus™, an electronic database for sustainable products in support of workers, so as to promote environmentally responsible procuring decisions. In addition, the Canadian government includes environmental requirements in its Material Management Policy. The policy designates that superiors are obliged to embrace ecological principles in every aspect of material management, from the planning and design stage to procurement, usage and disposal of materials (Wessels, n.d). Chowdhury et al., (n.d) assert that developed or technologically advanced countries like Canada have instituted GSCM practices in the building industry.

As the two largest and/or most populated of the 23 countries that make up North America, the USA and Canada formed the focus of this section of the study. This does not mean that other countries are not involved in green procurement, however.

Oceania, which includes New Zealand and Australia, are considered next.

2.2.1.4 Oceania (Australia and New Zealand)

The two most advanced countries in the area generally known as Oceania are Australia and New Zealand, both of which practise green procurement. Table 2.1 show summary of international GP practices profiled in these two countries.

a) New Zealand

New Zealand is fairly small and partners with Australia and others on matters to do with green procurement. In 2007, the Australian Procurement and Construction Council (APCC), in partnership with the New Zealand government, instituted the Australian and New Zealand Government Framework for Sustainable Procurement. The purpose was to support the governments of state, territory and commonwealth jurisdictions and New Zealand to follow sustainability guidelines during procurement for construction, commodities and amenities (Young, Nagpal & Adams, 2016).

b) Australia

Australia is an active implementer of green procurement on government projects and is also involved in green fabrication (Bohari et al., 2017). Following the 2002, World Summit on Sustainable Development, several developed countries, including Australia, publicised their commitment to sustainable practices in public purchasing (Oyewobi, Ija & Jimoh, 2017). However, a study by Ahsan and Rahman (2017) contends that currently in Australia there is no government law underpinning green procurement nationally. Each state has its own green procurement policy and each state healthcare system issues its own guidelines. This therefore confirms the non-existence of GPP legislation in the country despite individual state policies that exist. GPP continues to be executed irrespective of non-existing legislation. Ahsan and Rahman (2017) state that the Australian state could benefit from emulating the successful and relevant green procurement policies of other advanced states in particular the UK, Italy, Canada and Japan. On the other hand, Chowdhury et al., (n.d) contend that developed and technologically advanced countries like Australia have instituted GSCM practices in the building industry. Again, the fact that the study by

Chowdhury et al., (n.d) is undated makes comparison difficult; Ahsan and Rahman's study was conducted in 2017, and contends that there is no compulsory government law underpinning GPP in at least one area – healthcare.

Ahsan and Rahman (2017) also contend that Australia's public healthcare system in Victoria is concerned with suppliers' social, environmental and ethical practices, including their use of water, various products and energy, in addition to their production of waste. The authors affirm that individual states in Australia possesses its peculiar green procurement policy and issues its own purchasing standards, emphasising environmental safeguarding and value for money. Ahsan and Rahman (2017) avow that Queensland's purchasing policy objectives include providing excellence while supporting sustainability.

New Zealand and Australia are the only two countries in Oceania considered in this study – there are others, which might be examined for such data in further studies. The next continent to be considered is South America.

2.2.1.5 South America

Colombia and Brazil are the two South American countries of interest with regard to green procurement. Table 2.1 profiles a summary of international GP practices.

a) Colombia

Agyepong and Nhamo (2015) highlight that Bogota in Colombia has initiated green projects such as the TransMilenio bus rapid transit offering a cashless public transport system and low-emissions vehicles with the objective of reducing carbon emissions, dissuading the use of private cars, and encouraging cycling and walking. The authors also mention the development of a specially delineated right-of-way urban infrastructure which offers a variety of fast, comfortable, cost-effective bus operations. South Africa has followed Columbia's example with its own rapid bus transport infrastructure in Gauteng, Pretoria and the Western Cape, offering fast, reliable, low-emissions alternatives to private cars.

b) Brazil

Recent studies state that Brazil is the fifth-largest country on the globe by area and the most advanced economy in South America (Zhao, Miotto, Syal & Chen, 2019). A study by Da Silva et al., (2018) states that Brazil began to engage in sustainable fabrication and utilisation at the global level during the United Nations Conference on Environment and Development (ECO-92), and endorsed Global Agenda 21 in 1992. Agenda 21 came to global prominence only ten years later, and went a long way to reinforcing Brazil's commitment to green policies and practices. Some of Brazil's government tendering advertisements focuses over and above on economic aspect while others emphasise on environmental or social concerns. The country undergone interesting developments through framework of the law in the last few ages, especially with regard to sustainable public procurement. For instance, compliance with Complementary Act No. 123 (Lei Complementar No. 123, 2006) and Act No. 147 (Lei Complementar No. 147, 2014) is now enforced, specifically for the promotion of local micro enterprises (Da Silva et al., 2018).

The last continent to be considered is Africa, with the focus on Kenya, Zimbabwe, Ghana, Nigeria and Zambia. South Africa is considered separately.

2.2.1.6 Africa

Africa is one of the largest and poorest continents, comprising 54 countries, with only Kenya, Zimbabwe, Ghana, Nigeria and Zambia discussed hereunder and shown in Table 2.1.

a) Kenya

The Kenyan government has not entirely been left behind when it comes to green procurement, having introduced several actions aimed at abating its carbon footprint, for instance the use of energy saving bulbs (Moronge & Zawadi, 2018). Moronge and Zawadi (2018) assert that most large companies support the procurement of products that are energy efficient or make energy savings during manufacture. A study by Muraguri et al., (2015) states that the Kenyan government set up various policies, institutions and pieces of legislation to protect the environment, such as the

Procurement Regulations of 2006 and Public Procurement and Disposal Act of 2005. These authors contend that the government has succeeded in setting up an extensive network of policies and legislation to regulate all business activities to promote GP practices, in light of the Kenya Solid Waste Management bylaws of 2007 and Environmental Management and Coordination Act (EMCA) of 1999, the Factories Act (CAP 514 of the Laws of Kenya) and the Environmental Management and Coordination Regulations of 2006. The authors however, state that despite these measures, green procurement implementation in Kenya has been sluggish. One is forced to conclude that despite a proliferation of laws and policies, green procurement practice is still not a government priority in Kenya. Certain aspects of the private sector are highly committed to green procurement practice.

b) Zimbabwe

Chari and Chiriseri (2014) highlight that Zimbabwe has made substantial improvements in environmental management, women's rights, labour laws and children's rights, but sustainability issues are not yet integrated into procuring decisions by either public or private organisations. These authors conclude that sound sustainable procurement practices are not carried out in Zimbabwe and that cost is still the main criterion for awarding tenders. Little attention is paid to environmental and social considerations. Most organisations do not have a policy on sustainable procurement and there is no compulsion or direct incentive to carry out sustainable procurement. This means that issues such as child labour, effects on health, working conditions and environmental sustainability matters such as pollution are not major considerations when projects are considered.

The non-existence of green procurement practice in Zimbabwe is affirmed in a study by Pepurah, Brako and Akosah (2018) who state that low income countries (LICs), common in Africa, lack understanding and do not have policies or plans for environmental protection due to widespread poverty.

Nonetheless, some progress has been made by Zimbabwe on environmental matters which should be extended to the social and economic aspects so that people are able to see the relationship between the elements on the triple bottom line. Zimbabwe might also do well to emulate some of the examples of green projects in metropolitan areas close

by, such as in South Africa, despite not having legislation in place to compel such activities.

c) Ghana

Peprah et al., (2018) conducted a study entitled *The Awareness Level of Green Procurement at the District Assemblies in Western Region in Ghana*. They uncovered the existence of numerous regulations, laws and policies connected to the environment in Ghana. Policies exist to regulate land use and prevent deterioration, and to ensure the correct management of water bodies and animals, but there are no explicit laws or policies making green procurement mandatory in Ghana's government purchasing. The authors established that local 'assemblies' are involved in sensitisation around green purchasing, which formed part of the Public Procurement Amendment Act 914 of 2016. This Act aimed to promote the integration of ecological, social and economic matters during purchasing. 'Green industry and trade assessments, Ghana Environmental Reform Policy (2014) [and the] National Climate Change Policy (2013), and so on, are informing, educating, and sensitizing, according to these authors (Peprah et al., 2018).

The scholars conclude that while sustainable procurement is a powerful instrument of change in industrialised countries, it is still a new and untested concept in unindustrialised countries such as Ghana. Green procurement in the district assemblies of Ghana have not been incorporated.

Therefore, one may conclude from the literature that some measures are in place in Ghana to safeguard the environment through policies and regulations related to environmental protection, yet none are in place in relation to green procurement. Some efforts have been made to balance the triple bottom line of sustainability.

d) Nigeria

Nigeria is a developing country (Oyewobi et. al, 2017) in the west of Africa. Adebayo (2015) states that the public sector in Lagos has not optimised opportunities to entrench ecological, social and economic facets of sustainability into its operations. Oyewobi et al., (2017) uphold that the building sector in Nigeria still lacks economic,

social and environmental sustainability criteria compared to developed nations. These authors reviewed the Nigerian Public Procurement Act 2007, which shows no emphasis on sustainability. Furthermore, there are no explicit procedures, guidelines or mechanisms in place in Nigeria to incorporate sustainability initiatives into the purchasing process, despite Nigeria's membership of the United Nations Movement for Sustainable Development. Adebayo (2015) upholds that there is a lack of comprehensive and organisation-wide sustainability policy. However, the author points out that despite this lack of policy, some organisations recognise the necessity of sustainability as an element of business practice and have implemented sustainability initiatives on their own. This shows initiative and is a great example for other African countries where green procurement policies are absent and general awareness low. In Nigeria, more work is needed to reform the legislation in favour of green or sustainable procurement.

e) *Zambia*

Oke et al., (2019) conducted an enquiry entitled *Drivers of sustainable construction (SC) practices in the Zambian construction industry*. The country's building industry, like that of other emerging countries, shows low awareness of green construction practices, and in general there is a dearth of information pertaining to SC approaches in the Zambian building industry (ZCI). The study concluded that the status of green initiatives is low, as is awareness of SC activities amongst building specialists. A summary of international green procurement as practised by the countries under review is presented in Table 2.1 below.

Table 2.1: Global green procurement practices per category

Continent	Country	Category	Source	Key finding
Europe	UK	Legislation, policy, regulations	Ahsan and Rahman (2017).	UK government played a dominant role in enforcing green procurement through legislation
	Denmark		Da Silva et al., (2018); Dikgang et al., (2012)	Denmark has possessed compulsory adherence standards for sustainable or green public purchasing in government organisations since 1994. Introduced a tax on plastic bags in an effort to combat environmental degradation.
	Sweden		Geng and Doberstein (2007); Da Silva et al., (2018).	Sweden is included in the list of countries which now uphold a policy that at least 40% of all government purchases are green. The theme for sustainable procurement has been discussed since 1990, and has risen since 2007.
	Germany		Da Silva et al., (2018).	Germany is the first country to have introduced a sustainable or green public purchasing policy from 1986. GGP guiding principles have been followed in all government purchasing for nearly 20 years.
	Italy		Ahsan and Rahman (2017); Dikgang, et al., (2012).	A directive exists in Italy requiring 30% of goods bought by government to conform with environmental standards. A five-euro-cent levy on the fabrication of plastic bags was proclaimed in Italy in 1989.
Asia	Singapore		Bohari et al., (2017); Ofori, (n.d).	Singapore is a developed state where the practice of green procurement is advanced to the extent that they carry out green design. Building and Construction Authority (BCA) initiated the Green Mark Scheme within the construction sector effective January 2005. Guidelines for green

				expansion are published in the National Green Plan, first made public in 1992 and updated regularly.
	China and Hong Kong		Chowdhury et al., (n.d); Bamgbade and Babatunde (2017); Kahanaali et al. (2015); Wong et al., (2016).	Instituted GSCM practices in the building industry. Green construction guidelines were published by China's Ministry of Construction (MOC) in 2007. Regulatory enforcement influenced China's auto industry to adopt green supply chain approaches. Hong Kong has instituted numerous policy measures toward achieving sustainable development and promoting 'lower carbon' living.
	Japan		Agyepong and Nhamo (2015).	Japan was amongst the leading nation states to have instituted eco-labelling. The Green Purchasing Law was legislated in 1989 and enforced in 2001.
	Malaysia		Bohari et al. (2017); Chowdhury et al., (n.d).	There are no particular guidelines for GP in Malaysia's building and construction sector, where the practice is blurred and disjointed. However, a contradictory study (though not dated), state that developed or technologically advanced countries like Malaysia have instituted GSCM practices in the building industry.
	United Arab Emirates (UAE)		Athapaththu and Karunasena (2018).	The United Arab Emirates (UAE) administration moved to change its regulations aimed at fostering sustainability in the building sector.
North America	United States		Geng and Doberstein (2007); Patel and Giordano (2014).	GGP requirements have been in force in United States' public institutions at metropolitan, state and national levels in 1993 and have expanded since then. Environmental Impact Assessments (EIAs), was introduced in the United States as long ago as 1969 and have extended globally to other countries.

	Canada		Geng and Doberstein (2007); Ahsan and Rahman (2017); Chowdhury et al., (n.d); Wessels (n.d).	Canada introduced its 1995 <i>Directions on Greening Government Operations Policy</i> that establishes green government procurement as a primary strategy for environmental protection. Canada instituted a green reporting framework and enacted a Sustainable Development Act in 1998. Developed or technologically advanced countries like Canada have instituted GSCM practices in the building industry. Canadian government includes environmental requirements in its Material Management Policy. The policy designates that superiors are obliged to embrace ecological principles in every aspect of material management, from the planning and design stage to procurement, usage and disposal of materials.
Oceanian	New Zealand		Young, Nagpal and Adams (2016).	The Australian Procurement and Construction Council (APCC), in partnership with the New Zealand government, instituted the Australian and New Zealand Government Framework for Sustainable Procurement.
	Australia		Ahsan and Rahman (2017); Chowdhury et al., (n.d).	Currently in Australia there is no government law underpinning green procurement nationally. All member states in Australia possesses individual GP policies and government health institutions practise particular environmental purchasing standards incorporated beneath the principles of ecological safeguarding and value for money. Developed and technologically advanced countries like Australia have instituted GSCM practices in the building industry.
South America	Brazil		Da Silva et al., (2018).	There have been developments in the legal context of sustainable public procurement; for instance, enforcing

				compliance to Complementary Acts No. 123 (Lei Complementar No. 123, 2006) and No. 147 (Lei Complementar No. 147, 2014), specifically covering locally based micro enterprises.
Africa	Kenya		Muraguri et al., (2015).	Government of Kenya has set up various policies, both institutional and legislative; for example, the Procurement Regulations of 2006 and the Public Procurement and Disposal Act of 2005, meant to oversee companies' activities with the objective of protecting the environment. Government has set up an extensive network of policies and legislation to regulate business activities, such as the Factories Act (CAP 514 of the Laws of Kenya), Environmental Management and Coordination Act (EMCA) of 1999, the Environmental Management and Co-ordination Regulations of 2006 and the Kenya Solid Waste Management bylaws of 2007. Though, GP implementation has been sluggish.
Europe	UK	Environmental	Dadhich et al., (2014).	Safe and sound managing, nil waste to dumping grounds, efficient manufacturing and sustained partnering
Asia	Singapore		Ofori (n.d).	Singapore has inadequate land with only one landfill site; the country incinerates 90% of waste generated.
	China and Hong Kong		Kiggundu (2014).	China has instituted several environmental laws; for instance, the Pollution Prevention Law, the Environmental Protection Law.
	Japan		Agyepong and Nhamo (2015).	Tokyo engages in green practices, notably the reclaimed waste water and green building programmes.
North America	United States		Patel and Giordano (2014).	Environmental Impact Assessments (EIAs) were introduced in 1969 and thereafter extended to other countries.

Oceanian	Australia		Ahsan and Rahman (2017).	Australia's Victorian public healthcare area gives appropriate attention to suppliers' social, environmental and ethical practices, including use of water and energy and level of waste production.
Africa	Zimbabwe		Chari and Chiriseri, (2014).	Zimbabwe has made substantial improvements in environmental management; however, sustainability issues are not integrated into procuring decisions by either public or private organisations. Most organisations have no policy on sustainable procurement and it is not mandatory to carry out sustainable procurement.
	Ghana		Peprah, Brako and Akosah (2018)	Uncovered numerous regulations, laws and policies relating to the environment in Ghana.
	Nigeria		Oyewobi et al., (2017).	The building sector in Nigeria still lacks economic, social and environmental sustainability criteria.
	Zambia		Oke et al., (2019).	There is no legislation pertaining to sustainable construction or green procurement in Zambia.
Europe	UK	Procurement	Sourani & Sohail (2011); Ofori, (n.d).	There is an increased emphasis on sustainable purchasing in official reports published in the UK. Integrated environmentally safe purchasing across all services including goods, following the publication of the national strategic framework for achieving sustainability Securing the Future.
	Denmark		Moronge & Zawadi (2018); Muraguri et al., (2015).	Denmark demonstrates an exciting level of obligation to green public procurement, with 40% of government purchasing activities requiring evidence of 50% or more ecological principles.

	Sweden		Moronge & Zawadi (2018; Muraguri et al., (2015).	In Sweden, 50% of government purchasing activities comprise green principles of 50% or more.
Asia	Singapore		Bohari et al., (2017).	Singapore, as a developed state, is advanced in the area of green procurement, to the extent that they carry out green design and manufacture as well as procurement.
	Japan		Agyepong and Nhamo (2015).	In Japan, public institutions are forced to buy goods and services considered ecologically sound.
	Malaysia		Bohari et al., (2017).	Malaysia's green procurement emphasises on environmental impact, which has encouraged the building sector to strive for the purchase of green goods and services.
North America	Canada		Wessels (n.d).	Environment Canada established EcoNexus™, an electronic database of sustainably produced products in support of workers, so as to create environmentally responsible procuring decisions. Included 650 environmentally responsible materials in the specifications segment of the Canadian Federal Government's National Master Specification (NMS).
Oceanian	Australia		Ahsan and Rahman (2017)	Queensland's purchasing policy objective is to provide excellence in buying by, amongst other aspects, procurement that supports sustainability.
Europe	Germany	Energy	Agyepong and Nhamo (2015).	Berlin has a visibly successful narrative of energy-saving joint ventures between government and the private sector, where energy-saving firms are appointed for development projects

North America	United States		Agyepong and Nhamo (2015).	Philadelphia initiated a solar energy powered water purification plant to reduce carbon emissions, with solar panels and batteries converting sunlight into 250 kW per hour. On an annual basis the solar panels produce 300 000 kW of energy capable of powering around 28 homes.
	Kenya		Moronge and Zawadi (2018).	Introduced energy saving bulbs to conserve energy.
Europe	Italy	Transportation	Agyepong and Nhamo (2015).	Venice has initiated sustainable projects such as its Integrated Mobility Plan, comprising various sustainable projects aimed at slashing carbon emissions in the transportation sector by 35%. Tram lanes were erected, bike lanes marked out, electric vehicle charging stations constructed, motorbike and vehicle sharing arrangements established, and parking and riding amenities created to encourage individuals to make use of bus, trams or bicycles.
North America	United States		Chowdhury et al., (n.d); Agyepong and Nhamo (2015).	Technologically advanced countries like the USA and Canada have implemented GSCM practices in the building industry and extended such practices to other areas such as transportation. San Francisco switched to electronic and hybrid vehicles for its public fleets, thus reducing carbon emissions.
South America	Colombia		Agyepong and Nhamo (2015).	Bogota in Colombia has initiated green procurement projects such as the TransMilenio bus rapid transit system, offering low emission transport operated cashlessly. This reduces carbon emissions and encourages commuters to leave privately owned cars at home. The government also encourages cycling and walking.

This study has reviewed the literature associated with green procurement practices internationally, covering samples from six continents. For the purpose of this survey, South Africa is the focus and is considered on its own under section 2.2.2.

2.2.2 Green procurement practice in South Africa

Green procurement in South Africa's government sector is discussed below with specific reference to the national government and local municipalities. The fact that the provincial level is excluded from consideration may be considered a weakness of the study, since South Africa's public sector consists of national, provincial and local government levels. Green procurement initiatives on the national and local government level in South Africa is profiled in Table 2.2.

2.2.2.1 Green procurement practice at the national level

The World Summit on Sustainable Development, held in Johannesburg, South Africa, from 26 August to 04 September 2002, was a major milestone for sustainable procurement (Ruparathna & Hewage, 2015). At the summit, green or sustainable public procurement was proposed as one of many measures needed to combat climate change (Agyepong & Nhamo, 2016). By hosting this summit, South Africa affirmed its commitment to support worldwide efforts to combat the risk of climate change and environmental degradation, leading the continent by example. Thereafter, serious measures were taken by the South African administration to establish policy in support of sustainable development (Mewomo, et al., 2017). On the national level, the country has taken numerous measures to tackle sustainability challenges by means of a comprehensive green strategy, currently enclosed within the National Climate Change Response White Paper of 2011. Ozumba and Aduda (2015) list several laws and policies that support environmental protection, such as the National Water Policy, which focusses on efficiency, equity and preservation of the environment and lastly the National Environmental Management Act (NEMA), 1998 (Act 107 of 1998).

According to Wessels (n.d), developed states are still grappling with green procurement issues, and South Africa could take advantage of lessons learned

through the blunders made by developed countries. The Wessels study lacks a date of publication, making its findings difficult to assess. Muraguri et al., (2015) state that South Africa is classified among many countries to have incorporated environmental concerns into its procurement policies. Da Silva et al., (2018) maintain that emerging nation states like South Africa are investing around green procurement, whether by means of laws or green practices. However, Urban Seed (2012) states that green public procurement (GPP) is in its early stages in South Africa, with environmental standards only starting to feature in government purchasing decisions. Moronge and Zawadi (2018) aver that GP in South Africa is more or less brand-new and plays a small role in public procurement. These findings support the study by Agyepong and Nhamo (2015) which maintains that in South Africa, green procurement is still newfound and that there is no national policy to enforce it.

New concepts or products are often regarded as somewhat suspect when first introduced to a society or organisation, which naturally tends to cling to old, conventional methods and thinking. South Africa is no exception in this regard. Nhamo and Mjimba (2014) point out that South Africa has yet to shift its main energy source from coal to sustainable resources. However, some transition is evidenced in a media statement by the Department of Energy (DOE, 2018) affirming that the Department of Energy is committed to the signing of 27 Renewable Energy Independent Power Producers agreements subsequent to a lengthy period of uncertainty. The commitment is not only to renewable energy but to a strong collaboration with the private sector in pursuance of government's intentions for energy supply in the future. The South African government's energy policy lists various energy sources which include renewable methods of power production aimed at reducing carbon emissions, in line with commitments made at Paris (DOE, 2018).

The signing of agreements by the South African government and 27 renewable energy independent power producers indicates that the focus for green procurement seems to be mostly energy conservation and general environmental protection. This is confirmed by amendments made to the building regulations in 2011 through South African National Standards (SANS 10400 – XA, 2011). Part X of SANS focuses on environmental sustainability while part XA focuses on energy use in buildings.

2.2.2.2 Green procurement practice at the municipal level

GP practices in South Africa's municipal level for eThekweni, City of Cape Town, City of Tshwane, Nelson Mandela Bay, City of Johannesburg and Ekurhuleni respectively have been encompassed in Table 2.1 (South Africa).

Agyepong and Nhamo (2015) explain that South Africa's municipalities (local government) comprises of three types; Metropolitans (Category A), District (Category C) and Local (Category B). Nhamo and Mjimba (2014) state that local governments are the first and proper respondents to climate change challenges. The authors explain that this is so because climate change is a local issue and, in a three-tier system of government, local government is far more aware of local changes and particular challenges than central government. According to Agyepong and Nhamo (2015), local governments have the potential to make a difference through green procurement policies and plans, and plenty of opportunity to address the risks associated with climate change.

This study reviewed the literature to look at the modern practice of green procurement in metropolitan (category A) municipalities. Category B and C municipalities do not form part of the scope of this study. South Africa has eight metropolitan municipalities, with this study focusing on six: eThekweni, City of Cape Town, City of Tshwane, Nelson Mandela Bay, City of Johannesburg, and Ekurhuleni. Urban Seed (2012) states that Nelson Mandela Bay, eThekweni, Tshwane, Ekurhuleni and Cape Town, as members of the International Council for Local Environmental Initiatives (ICLEI), pledged at the World Summit on Sustainable Development (WSSD) in 2002 to follow certain types of eco-friendly procurement. However, carrying out GP practices in most metropolitans has been sluggish, mostly due to a lack of capability to steer the work and minimal rolling out of the process (Urban Seed, 2012). Metropolitan municipalities in South Africa have at least drafted plans to tackle energy efficiency and changes in climate, and some have gone further than others in implementation (Nhamo & Mjimba, 2014).

a) The City of Cape Town

The City of Cape Town has achieved substantial progress in green procurement, according Agyepong and Nhamo (2015). Efforts are in place to collate all green

procurement policies into a single policy document. According to Agyepong and Nhamo (2016), the City of Cape Town does have a stand-alone green procurement strategy. Agyepong and Nhamo (2015) assert that the City has followed other metropolitan municipalities in South Africa in procuring low emission buses, establishing the bus rapid transit (BRT) to embark on a low carbon journey. The authors also mention that in August 2014, the City established a unique, first 'green' taxi rank in South Africa as part of its Integrated Metropolitan Environmental Policy (IMEP). The taxi rank is powered by a solar powered system mounted on the roof, producing electricity that meets all the rank's power needs. The rank is also distinguished by a rain water collection system, which provides 70% of the rank's massive water needs via collected rain water held in a below-ground reservoir. This is particularly valuable in view of the drought and resulting water crisis that has hit many parts of South Africa, particularly Cape Town. The use of harvested and recycled rain water at local government level is a huge boast for the municipality and effects a great saving on water bills while going some way to combatting climate change. Together with the use of solar power, the municipality is showing that green procurement makes environmental and economic sense. The city is on the right track with regard to green procurement implementation.

b) Nelson Mandela Bay Metropolitan

According to Agyepong and Nhamo (2015), the Nelson Mandela Bay Metropolitan (NMBM) has also made substantial progress in support of green procurement, with its environmental policy including a green procurement strategy. Its Integrated Environmental Policy (2012) alludes to green procurement, and it also has a separate green procurement strategy (Agyepong & Nhamo, 2016), developed in 2011. On its database of service providers, provision is made for certificates certifying the ecological trustworthiness of service providers (IISD, 2014). In addition, Agyepong and Nhamo (2015) state that NMBM initiated its BRT system in 2010 so as to fulfil the demands of the World Cup at that time. The system was suspended for three years due to concerns with poorly built roads, but in 2013 was resumed in an effort towards reduction of metropolitan's carbon footprint.

NMBM needs to devote more effort to boosting green procurement through sustainable projects such as green taxi ranks, as has been done in Cape Town. Taxi ranks are among the busiest and most water-intensive areas associated with the country's transport system, and the greening of taxi ranks would go a long way to raising the city's level of green compliance.

c) Johannesburg Metropolitan

Johannesburg Metropolitan is a major greenhouse gas (GHG) emitter because of its high population density and the fact that it is home to the key manufacturing sector and the service industry (Nhamo & Mjimba, 2014). Patel and Giordano (2014) argue that South Africa is a frontrunner among the relatively unindustrialised countries, especially with regard to instruments, policies and practices to do with environmental protection.

The City has established several sustainable projects such as its modernised BRT system (a legacy of 2010 World Cup), and South Africa's first rapid train system, the Gautrain, intended to condense the metropolitan's carbon footprint (Agyepong & Nhamo, 2015). BRT's implementation has encountered barriers from the taxi industry, not only in Johannesburg Metropolitan but elsewhere, despite its obvious benefit of lowering congestion and reducing the transport sector's carbon footprint. Johannesburg Metropolitan is the first South African city to have introduced the BRT, enabling other municipalities to learn from its failures and successes.

The acquisition of buses that generate lower carbon emissions is a small but valuable aspect of a city's green procurement, and indicates the willingness to move in this direction despite obvious political fall-out, as is the case where opposition erupts from a sector as influential as the taxi industry. Johannesburg Metropolitan is amongst the older municipalities, possess a waste management policy and an environmental policy that make use of some aspects of green procurement (Agyepong & Nhamo, 2016).

d) The City of Tshwane

The City of Tshwane crafted the Tshwane Integrated Environmental Policy (TIEP) to ensure the practice of ecologically green policies (IISD, 2014), and referred to green procurement as far back as 2005 (Agyepong & Nhamo, 2016). The objective of TIEP

is to ensure that all municipal departments take the environment into consideration in the execution of their daily responsibilities (IISD, 2014). The literature further reveals that despite TIEP, which expresses an overall awareness of environmental matters, the municipality lacks an overall green policy direction and a specific focus on green procurement; it thus uses distinct policies to effect green procurement actions.

Like Cape Town and Johannesburg, the city also has its own rapid bus transport system, the Tshwane Rapid Transit (TRT), known as *A Re Yeng* ('Let's go'). The buses are designed to release lower volumes of pollutants than ordinary buses do (Agyepong & Nhamo 2015). The fact that an overall green procurement policy is unavailable in the municipality does not prevent it from implementing sustainable projects for public benefit, at present and, it is hoped, in the future.

e) Ekurhuleni Metropolitan

Ekurhuleni Municipality has sustainable projects in place, such as its solar photovoltaic power plant, producing around 200kw of power from 860 solar panels (Agyepong & Nhamo, 2015). Solar powered electricity generation makes sense in a country where sunlight is in such plentiful supply; it saves on costs and is better for the environment. However, its downside is that the proliferation of solar farms robs the economy of jobs, particularly the jobs of unskilled and semi-skilled people such as drivers and miners. Supplies of coal are however finite and it is inevitable that the country will switch from coal-fired power to alternative sources in the end, as Ekurhuleni is already demonstrating.

Agyepong & Nhamo (2015) state that other supplementary carbon limiting projects in Ekurhuleni include the substantial distribution of solar-driven water heaters to low-income homes, the remodelling of municipal buildings with energy efficient lighting and cooling and the fitting of energy efficient roadside lights, with mercury lightbulbs replaced by globes made of high-pressure sodium. Many roadside lights are also solar-powered. These comprise a light-emitting diode designed for energy efficiency, a solar panel above each light capable of supplying 12 hours of illumination at night, and solar-driven batteries that store 48 hours of extra energy for support during overcast days.

Overall, however, Ekurhuleni Metropolitan Municipality lacks green policy direction and uses separate policies to fulfil green procurement actions (Agyepong & Nhamo, 2015). Agyepong and Nhamo (2016) point out that the metropolitan alludes to green procurement in its 2013 environmental policy document. It can be said that Ekurhuleni embraces green procurement in certain policy documents but lacks a cohesive green procurement plan.

(f) eThekweni Metropolitan

Like most municipalities in South Africa, eThekweni Metropolitan lacks a stand-alone green policy document and uses different policies to implement green procurement actions (Agyepong & Nhamo, 2015). Nonetheless, efforts are in place to include green procurement in various documents such as the SCM policy (2013). The metropolitan also alludes to green procurement in its 2013 environmental policy document (Agyepong & Nhamo, 2016). It may be said that eThekweni embraces the sustainability concept in line with South Africa's international commitments.

Table 2.2: South African green procurement practices per category.

Continent	Level of Governance	Category	Source	Key finding
Africa	National (RSA)	Legislation, policy and regulations	Mewomo, et al., (2017); Agyepong and Nhamo (2015); Moronge and Zawadi (2018); Agyepong and Nhamo (2015); Muraguri et al., (2015)	Serious measures were taken by the South African administration to establish policy in support of sustainable development, following the WSSD. GP in South Africa is more or less brand-new and plays a small role in public procurement. In South Africa, green procurement is still newfound and that there is no national policy to enforce it. South Africa is classified among many countries to have incorporated environmental concerns into its procurement policies.
	National (RSA)		Da Silva et al. (2018)	Emerging nation states like South Africa are investing around green procurement, whether by means of laws or green practices.
	Municipal		Agyepong and Nhamo (2015).	The City of Cape Town has achieved substantial progress in green procurement and efforts are in place to collate all green procurement policies into a single policy document.
			Agyepong and Nhamo (2015).	Ekurhuleni Metropolitan Municipality lacks green policy direction and uses separate policies to fulfil green procurement actions.

			Agyepong and Nhamo (2015).	Like most municipalities in South Africa, eThekwin Metropolitan lacks a stand-alone green policy document and uses different policies to implement green procurement actions.
Africa	National (RSA)	Environmental	Ozumba and Aduda (2015).	South Africa has passed several laws and policies such as the National Water Policy, focusing on efficiency, equity as well as environmental preservation and lastly the National Environmental Management Act (NEMA) of 1998 (Act 107 of 1998).
			Urban Seed (2012)	Green public procurement (GPP) is in its early stages in South Africa, with environmental standards only starting to feature in government purchasing decisions.
				Amendments made to the building regulations in 2011 through South African National Standards (SANS 10400 – XA, 2011). Part X of SANS focuses on environmental sustainability
	National (RSA)		Patel and Giordano (2014)	South Africa is a frontrunner among the relatively unindustrialised countries, especially with regard to instruments, policies and practices to do with environmental protection.
	Municipal		Agyepong and Nhamo (2015)	The City of Cape Town established a unique, first 'green' taxi rank in South Africa as part of its Integrated Metropolitan Environmental Policy (IMEP).
			Agyepong and Nhamo (2016)	Johannesburg Metropolitan, being one of the older municipalities, possesses an environmental and

				waste management policy that promotes green procurement.
			Agyepong and Nhamo (2015); Agyepong and Nhamo (2016)	Nelson Mandela Bay Metropolitan (NMBM) has also made substantial progress in support of green procurement, with its environmental policy including a green procurement strategy. Its Integrated Environmental Policy (2012) alludes to green procurement, and it also has a separate green procurement strategy, developed in 2011.
			Agyepong and Nhamo (2016).	The City of Tshwane crafted the Tshwane Integrated Environmental Policy (TIEP) to ensure the practice of ecologically green policies (IISD, 2014), and referred to green procurement as far back as 2005. The objective of TIEP is to ensure that all municipal departments take the environment into consideration in the execution of their daily responsibilities (IISD, 2014).
			Agyepong and Nhamo (2016).	eThekweni Metropolitan alludes to green procurement in its 2013 environmental policy document.
Africa	National (RSA)	Energy	Nhamo and Mjimba (2014)	South Africa has yet to shift its main energy source from coal to sustainable resources.
			Department of Energy (DOE, 2018)	Department of Energy committed to the signing of 27 Renewable Energy Independent Power Producers agreements subsequent to a lengthy period of uncertainty.

			Department of Energy (DOE, 2018)	The South African government's energy policy lists various energy sources which include renewable methods of power production aimed at reducing carbon emissions, in line with commitments made at Paris.
	National (RSA)			Amendments made to the building regulations in 2011 through South African National Standards (SANS 10400 – XA, 2011). Part XA focuses on energy use in buildings.
	Municipal		Nhamo and Mjimba (2014).	Metropolitan municipalities in South Africa have at least drafted plans to tackle energy efficiency and changes in climate, and some have gone further than others in implementation
	Municipal		Agyepong and Nhamo (2015).	Ekurhuleni Metropolitan has introduced sustainable projects, for instance, the solar photovoltaic power plant which produces around 200 kW of power from 860 solar panels. It has widely distributed solar powered geysers to low-income homes, remodelled municipal buildings for energy efficacy, and has installed energy efficient roadside lights, replacing mercury lightbulbs with globes made of high-pressure sodium; also, solar powered roadway lights.
	Municipal		Agyepong and Nhamo (2015)	In August 2014, the City of Cape Town established a unique, first 'green' taxi rank in South Africa. The rank is powered by a solar powered system

				mounted on the roof, producing electricity that meets all the rank's power needs.
Africa	Municipal	Transportation	Agyepong and Nhamo (2015).	The large metropolitans have launched various green rapid transportation projects: (1) NMBM implemented the BRT system in 2010. (2) Johannesburg established its bus rapid transport (BRT) system as a legacy of 2010 World Cup and introduced South Africa's first rapid train (the Gautrain) to diminish the municipality's public transportation carbon footprint (Agyepong & Nhamo, 2015). (3) City of Cape Town procured low-emission buses and established the BRT system aimed at embarking on a low carbon journey. (4) Tshwane launched the Tshwane Rapid Transit (TRT), known as <i>A Re Yeng</i> ('Let's go'). The buses are designed to release lower amounts of injurious gases into the environment.

2.2.3 Summary of global and South African green procurement practices

From the literature, it is clear that countries in Europe for example the United Kingdom (UK), Denmark, Sweden, Germany and Italy are advanced in the theory and practice of environmental protection and, by extension, green procurement. The key drivers are various pieces of legislation and compulsory standards enforced by governments that compel government departments to purchase goods and services showing evidence of certain minimal standards of environmental sustainability in their manufacture and use. Green supply management practices have been extended to include most activities of the European governments under review.

Many countries in Asia (Singapore, China and Hong Kong, Japan, Malaysia and the United Arab Emirates) are also committed to green procurement practices. GSCM is practised in the construction industry and other sectors due to the pressure of several laws and policies. For example, Japan enforces environmentally friendly standards in the design of large buildings while in Malaysia construction practitioners are 'urged' to engage in green approaches and purchase green goods and services. Despite these measures, Asia lags behind Europe in the practice of green procurement, and some, such as Bangladesh, do not practice it at all, according to Chowdhury et al. (n.d).

Countries located in the continent of North America are committed to environmental sustainability by use of green procurement. In the USA, green procurement requirements were established in public institutions at the metropolitan, state and national levels since the first initiative in 1993. Since then, these practices have been expanded and include the building industry – meaning that in 2020, the country has a 27-year history of practising green procurement.

Among the Oceanic countries, New Zealand and Australia were examined. Both are developed countries and have been implementing green procurement in most government departments including construction. However, it is interesting that according to the literature, Australia still lacks green procurement laws in sectors such as healthcare. Individual green procurement policies are in place in every state in the country, pending the passing of national laws. New Zealand prides itself as a country that espouses and practises sustainability guidelines for procurement during construction and the purchasing of commodities and amenities.

For the continent of South America, Colombia and Brazil were studied, and were found to practise green procurement. Bogota in Colombia initiated several green procurement projects such as the TransMilenio bus rapid transit system, using low-emission buses operating on a cashless system. This government discourages the use of privately owned cars in cities and encourages walking and cycling. The bus rapid transport systems of South African cities such as Gauteng, Pretoria, and Cape Town were modelled on the South American system. Brazil has enacted several Acts in support of green procurement, with tender notices focusing on the three-fold aspects of sustainability – economic, environmental and social.

From the countries studied in Africa – Kenya, Zimbabwe, Ghana, Nigeria and Zambia – it is clear that the practice of green procurement lags behind that of many other countries. Most of the African countries studied have environmental laws in place, but lack cohesive legislation referring specifically to green procurement. The concept is still new and clearly not a priority in the majority of African countries, including South Africa, where poverty is still rife and corruption hampers progress. In South Africa green procurement is still new on the national, provincial and municipal levels. However, the public sector uses alternative measures to support GP. The national government level has formulated several laws and policies to combat climate change. For example, the Carbon Tax Act No 15 of 2019 was promulgated, introducing fines for excessive greenhouse gas emission. In SA the public sector is a dominant client and initiator of projects, therefore one might reasonably expect alignment between national legislation and NDPW practice.

Most of South Africa's metropolitan municipalities (at municipal level), practise a measure of GP, but lack specific green procurement policies. These municipalities are not waiting until specific green policies are in place, but have realised the risk posed by climate change and are trying to pursue mitigation projects and purchasing environmentally-friendly products and services. However, in practice they sometimes lag. Comprehensive green procurement is unlikely to take off without political and top management support, and greater awareness of commitments made at the international level. Some metropolitans mention green procurement in their environmental policies and are implementing mitigation projects such as green taxi ranks, BRTs and the mass rollout of solar geysers in support of green procurement.

South African municipalities that have not started could well benefit from following the example set by metropolitans, learning from their successes and mistakes.

Green procurement practice has been discussed internationally, and in South Africa at the national and municipal level. A tabulated summary of green procurement practices (Table 2.1 & 2.2) was presented to show practices per continents and country. From the literature and above, it was possible to deduce certain drivers or enablers of GP practised by countries, as discussed in the following section.

2.3 Green procurement practice enablers/drivers

This section of the study examines the drivers or enablers linked to green procurement execution, also known as green supply chain management or sustainable procurement practice. Green drivers are forces that pressurise or stimulate companies or organisations to execute green practices (Niemann et al., 2016; Tobescu & Seuring, 2015; Balasubramanian & Shukla, 2017). Jia et al., (2018) state that drivers refers to the pressures either inside or outside a company that compel it to implement SSCM. The authors argue that the drivers in companies within certain sectors have a tendency to be identical, irrespective of the seller environment, and are reinforced by other drivers such as the institutionalised setting and rule-based organisational structures. Various sectors experience unique drivers specific to the sector, even within the same country. Drivers in the public sector tends to differ from those in the private sector. The following drivers are discussed as derived from literature.

2.3.1 Government legislation or policy

Niemann et al., (2016) state that government regulations are the key driver when it comes to effective application of the green supply chain in India's manufacturing sectoral. The authors further state that government may play a role as either barrier or driver for the implementation of GSCM. At times it is a barrier due to a lack of regulations or poorly formulated regulations, and at times it is a driver as a result of promulgating relevant, specifically worded regulations or laws.

Many authors concur that well-defined legislation and general regulatory support for green procuring is a stimulus for green public purchasing in numerous countries (Ahsan & Rahman, 2017; Bohari et al., 2017). Green procurement weakens when public administration invests in strategies and policies aimed at promoting lower carbon practices, but unfavourable conditions prevail in the local supply of such products and services (Agyepong & Nhamo, 2015). Ismail et al., (2017) affirm that the possibility exists of controlling and managing sustainability through the application of policies and through political encouragement, but it is not always a simple matter. Government regulations and legislation are nonetheless a key driver for successful green supply chain management (Moronge & Zawadi, 2018; Testa et al., 2014; Kiggundu, 2014).

2.3.2 Incentive-based policies

The Malaysian government has led the way in the area of incentive-based policies, providing incentives or inducements to inspire stakeholder participation, even though the country lacks specific guidelines at the project level (Bohari & Xia, 2015). Various authors concur that government provision of incentives is a key driver for sustainable design and green procurement. Government backing by means of subsidises for suppliers and producers of green products and services is crucial for developing a green supply network (Athapaththu & Karunasena, 2018). Policies carrying incentives are deemed a persuasive method of encouraging companies to implement ecologically friendly strategies (Wong et al., 2016; Ruparathna & Hewage, 2015). A study by Bohari et al., (2017) affirms the need for environmental attention and awareness, the need to make green procurement mandatory, the need to improve systems and the need to provide incentives and recognition for companies that excel in environmentally friendly practices.

2.3.3 Customer demand or pressure

Many authors point out that members of society are the end-user customers of public purchasing and that their opinions and attitudes to green products and services are an important driver of green procurement (Ahsan & Rahman, 2017; Kiggundu, 2014). Public pressure is also a key driver for the sustainability supply chain (Tobescu &

Seuring, 2015; Balasubramanian & Shukla, 2017). Environmentally aware customers can and do boycott products and services that are not environmentally friendly so as to force non-compliant companies or organisations to implement greener supply chains. Niemann et al., (2016) maintain that purchasers' needs in relation to sustainable services and products are one of the most vital enablers for eco-friendly approaches by companies. Consumers have the power to change company policies and practices by sheer numbers, and by being active citizens. They pressurise businesses to carry out greener supply chains which would eventually limit the damage caused to the natural world (ibid). In addition, for activities such as construction projects, clients have a high impact in terms of scope determination, specifications and procurement method to be followed (Kiggundu, 2014). A study by Oke et al., (2019) states that the client is the most significant enabler when it comes to the approach used in supply chain management, directly influencing supply source, cost, value and method. Customers, whether individual consumers or government departments, are therefore key to ensuring compliance with regard to green specifications of products or services; what to buy and what not to buy, given their purchasing power.

2.3.4 Government purchasing power

Governments are among the main procurers in an economy, with an expenditure of 45–65% of their budget on procurement (Urban Seed, 2012). Procurement of materials and the services of contractors and consultants has to take place for the State to render services to the community in every country. Municipalities in South Africa are the main procurers of products and services, spending millions of Rands annually on items as diverse as stationery, building materials and maintenance, vehicles etc. (Wessels, n.d). Green procurement at government levels therefore becomes a useful policy instrument and minimiser of waste, having a massive influence on a country's overall level of sustainable practice, given the scale of purchasing by governments. Public institutions and government departments have strong public purchasing powers that can change tendencies in the production and use of products, and can stimulate societal pressure for eco-friendly goods and services (Genga & Doberstein, 2007; Testa et al., 2014). Because of their procuring power, governments can play a strong role in stimulating and driving markets aimed at sustainable

production, especially when key officials are committed to green principles (ibid). Government is a customer and therefore this driver comes down to 'customer demand'.

2.3.5 Industry standards

Many authors concur that functioning guidelines and standards – such as appraisal standards, green label schemes, green specifications and International Organisation for Standardisation (ISO) 14000 accreditation – are an operative way to improve the application of green procurement (Wong et al., 2016; Bohari & Xia, 2015). Bohari et al., (2017) identify the following motivators for the adoption of green procurement:

- a) Industry standards such as those provided by the International Organisation for Standardisation (ISO) 14001 and the Environmental Management System (EMS) can play an effective part in guaranteeing green practices.
- b) Eco-labelling schemes offer guiding principles and promote awareness, helping interested parties with their selection of eco-friendly products and services.

The literature confirms that industry standards and guidelines promote sustainability or green procurement and therefore are key drivers.

2.3.6 Top management support

According to a study by Urban Seed (2012), one of the key factors affecting the achievement or failure of green procurement policy is understanding and buy-in specifically from top management, politicians, etc. Other authors concur that the backing of senior managers is a key internal driver of ecologically responsible purchasing (Ahsan & Rahman, 2017; Ruparathna & Hewage, 2015). A company or organisation's top management must make certain to establish procedures which reflect sustainability right through the entire purchasing process and to provide the necessary resources (Tobescu & Seuring, 2015). Kiggundu (2014) states that the dedication of executives and shareholders, along with their desire to reduce costs, lower pollution and eliminate waste, is a driver for green practices. Top management is an enabler when it implements green procurement, establishing the necessary

support structures and providing the necessary resources. They can also be a significant barrier when they fail to provide such support.

2.3.7 Company brand image and good name

A study by Niemann et al., (2016) states that a green 'look' is an enabler of GSCM, projecting a 'green image' which somewhat influences organisational practices. A green image means that a company is positively identified by consumers. The literature concurs that companies which engage in green practices enhance their brand image, which can reflect in increased sales and market share (Yu et al., 2018; Balasubramanian & Shukla, 2017).

2.3.8 Economic benefit

According to Kahanaali et al., (2015), GSCM as an approach for sustainable development has multiple benefits in today's competitive market, concurrently reducing environmental risks and conferring financial benefits on organisations. Niemann et al., (2016) avow that economic benefits could be the driving force of GSCM, since the practice has the potential to decrease unit prices of fabricated commodities or amenities without affecting planned usage or diminishing product quality. Companies not willing to adopt green practices may be isolated by customers and susceptible to losing business to competitors.

2.3.9 Environmental activism/advocacy

Ahsan and Rahman (2017) upholds that external parties such as non-governmental organisations (NGOs) can have a decided influence on the practice of green procurement, pressurising companies to change their attitudes and practices. NGOs play a significant role, raising awareness and setting standards of acceptable corporate behaviour. At times they campaign for and monitor ecological management application in state purchasing (ibid). Jia et al., (2018) concur that external stakeholders such as NGOs are external drivers for SSCM implementation.

Therefore, NGOs are affirmed as key drivers for the practice of green procurement, particularly in South Africa, where NGOs have long played an active role in shaping societal attitudes.

2.3.10 Availability of green practitioners

Windapo (2014) states that the construction industry involves many stakeholders and different trades. The author points out that architectural, mechanical and electrical designers are the most ideally positioned to undertake a green path because their designs affect the building envelope, choices of materials and energy efficiency. This view is supported by Ndou and Aigbavboa (2017), who state that architects and mechanical and electrical engineers have an influence on 'green' construction design due to the materials and energy efficiency choices these professionals make. Windapo (2016) and Ndou and Aigbavboa (2017) concur with these studies. Akadiri et al., (2012) assert that architects, engineers and other designers participating in the process of construction have a unique opportunity to reduce a project's impact on the environment at the design stage through the application of sustainability principles. There is no doubt that civil and structural engineers, too, influence the use of green procurement since they can specify the use of environmentally friendly and recyclable materials. The client, however, is still key; they bring pressure to bear on designers, urging them to adopt 'green' approaches, particularly in developing countries where green practices are not legislated. In many cases, clients will make such choices because of the enhanced income they may expect from renting or selling buildings that incorporate green design elements.

2.3.11 Introduction of the green concept in school syllabuses

Environmental management of the near future will be carried out by those who are still in school; hence, as stated by Bohari et al., (2017), it is important to incorporate environmental awareness and knowledge in school syllabuses. Teaching green concepts at an early stage (primary and high school) would have a significant positive impact on society as the message would be spread at home while children are at school, and would, of course, be carried forward to their working lives.

An educational programme for sustainable construction also needs to be included in university courses as part of certain degree or technical programmes (Oke et al., 2019). The sustainability approach facilitates the preservation of substantial resources for use by upcoming generations and simultaneously protects our ecosystem, making for a healthier and safer world (Higham et al., 2018; Othman & Abdelwahab, 2018; Niemann et al., 2016; Akadiri et al., 2012 ; Vink et al., n.d). Course facilitators and providers of on-the-job training ought to introduce green or sustainability concepts in their teaching of various disciplines, in order to raise awareness and reinforce environmental principles in the undertaking of diverse projects.

2.3.12 Cooperation amongst key stakeholders

The meaningful participation of interested and affected parties is a significant driver for the effective practice of green procurement. Sustainable sourcing requires numerous stakeholders (Chari & Chiriseri, 2014; Ruparathna & Hewage, 2015). Wong et al., (2016) state that understanding, mutual commitment and teamwork amongst participants substantially facilitates successful green supply chain management. Coordination amongst interested parties in the supply chain has been found to be key when parties are striving for the integration of eco-friendly concerns into supply chain administration (Jia et al., 2018; Braganca et al., 2014). Government and all its spheres, including state owned enterprises, cannot be left out of the practice of green procurement; their behaviour should be influenced by the imperative to 'go green', since the responsibility for sound environmental practice belongs to all stakeholders involved in projects, especially construction projects.

Based on the literature, one can conclude that the responsibility for effecting green procurement belongs to all participants in the supply chain system. Government, as policy developer, must be capacitated to play their role. Designers must play theirs by stipulating the use of 'green' materials and methods, and manufactures must play theirs by manufacturing and marketing products that incorporate green principles in their manufacture, composition and use.

2.3.13 Competitive advantage

Companies practising green procurement have the opportunity to surpass competitors when tendering for green contracts, and create greater opportunities to expand internationally. Emuze et al., (2015) list the paybacks of sustainable construction as firm reputation, competitive advantage, general financial inducements, client value creation, achieving customer demands and good public relations. Wyawahare and Udawatta (2017) avow that construction companies can enhance their competitive advantage through employing green practices. Corporations implementing GSCM will not only increase their competitive advantage by attracting clients to their ethical and green image, but will qualify for loans and tax reductions and will certainly enhance their chances acquiring state tenders. Athapaththu and Karunasena (2018) maintain that green construction is advantageous for corporations involved, since it raises productivity and performance and results in comparative strength.

This subsection has highlighted the drivers or enablers of green procurement, also known as green supply chain management or sustainable procurement practice as derived from the literature. The following section discusses the barriers associated with green procurement practice.

2.4 Barriers associated with green procurement

This section outlines various barriers to green procurement and suggested mitigations to overcome them. Barriers are forces that restrict or obstruct a company from executing green practices (Balasubramanian & Shukla, 2017). Jia et al., (2018) state that barriers are difficulties that stop or delay the acceptance of sustainable supply chain management (SSCM) practices in developing countries. The following barriers to GP implementation and mitigation factors were identified in line with the literature.

2.4.1 Resistance to change

This psychological barrier is cited by numerous scholars, including Muraguri et al. (2015) who cite resistance to green procurement in Kenya. They explain that resistance to change is common when workers assume new procedures will have to be learned.

In addition, a more general institutional inertia prevails when organisations simply refuse to change, inhibiting the development of new and beneficial procurement policies (Moronge & Zawadi, 2018; Wessels, n.d). Bohari et al., (2017) established that new graduates, exposed to sustainability concepts at tertiary education level, often encounter industry resistance when attempting to implement 'green' ideas. One of the reasons for resistance may be the fear of job losses (ibid). Change is often painful while it lasts and this can cloud the vision of employees who fail to see the long-term benefits.

In order to defeat this obstacle, Muraguri et al., (2015) point out that motivation of employees is warranted when resistance to change is encountered; employers should encourage workers to see the advantages of fresh procedures and habits. According to a study by Urban Seed (2012), organisations need to be aware of resistance to change and take steps to reduce its impact. Organisations intending to undertake substantial changes in the implementation of green procurement ought to invest resources and attention in overcoming this barrier.

2.4.2 The price of a green product or service

The price of green products is often cited as a barrier to green procurement. The literature confirms that the general understanding of building industry practitioners is that the implementation of environmentally friendly methods always involves additional costs (Karunasena, Rathnayake & Senarathne, 2015; Ahsan & Rahman, 2017). Balasubramanian and Shukla (2017) concur that barriers in the UAE include high prices. Moronge and Zawadi (2018) maintain that green or socially responsible manufacturing is seen as more expensive and leads to escalated prices for sustainable commodities in comparison with those not deemed 'green'. They point out that usually green products are more costly than other products due to the need for additional staff training and the time it takes to engage with suppliers. Costs are incurred during delays often associated with the implementation of sustainable practices (Yu et al., 2018). Delays are inevitable when firms are not accustomed to green practices, and government incentives may go some way to mitigating against such additional costs. Urban Seed (2012) argues that motivation to accept the costs of sustainable product or services may be found in the fact that they last longer than

inexpensive, less environmentally friendly ones. However, Akadiri et al., (2012) contend that a sustainable project can be cheap to construct, durable and involve moderate maintenance; in addition, they ought to be recyclable when the structure is demolished or decommissioned.

The cost barrier still deters consumers from adopting or purchasing green products or services due to lack of funds or lack of understanding of the bigger picture, which is to limit further damage to the environment.

To eradicate the price perception, champions within organisations need to challenge the perception that green products are more expensive; they may be, initially, but over the long term, they tend to work out more cheaply (Urban Seed, 2012). Client and consumer education are needed, where examples are shown of successful green practices; the electricity department of the City of Cape Town, for example, uses expensive transformers that last much longer than inexpensive ones (Urban Seed, 2012). Government should provide price subsidies for supplier that use green products and methods (Ahsan & Rahman, 2017). This move will promote more widespread green practice.

2.4.3 Lack of knowledge

Sustainable procurement is intensifying in several nation states, however knowledge and understanding remains inadequate in most developing countries (Muraguri et al., 2015; Wessels, n.d; Chowdhury et al., n.d). Balasubramanian and Shukla (2017) concur that an internal barrier in the UAE, for instance, includes a lack of knowledge and awareness of green practices. Moronge and Zawadi (2018) affirm that the main obstacle to the adoption of green procurement in Zimbabwe is lack of knowledge. A review of the literature makes it clear that lack of comprehension and information on green policies are a common obstacle to green procurement (Ahsan & Rahman, 2017; Yu et al., 2018). Unfamiliarity with the concept is cited by all research conducted in African countries and the UAE that formed part of this study.

Niemann et al., (2016) point out that to overcome this barrier, key personnel in organisations require training and advanced technology to raise their awareness of the value of green procurement. Tobescu and Seuring (2015) avow that workers also

need to improve their knowledge of sustainability production methods in the supply chain, which can only be achieved through training. Wessels (n.d) reports that inadequate knowledge is a barrier to green procurement and a constraint in municipalities or organisations in most developing countries, requiring training and awareness raising. Organisations ought to provide resources and advanced technology to enable staff to adapt to changes in order overcome their lack of knowledge on this crucial area.

2.4.4 Lack of information

Testa et al., (2014) state that access to relevant information is cited by 280 public procurers from 20 nation states as a barrier to green procurement. The non-existence of information is also classified amongst the hindrances to the adoption of green procurement by Agyepong & Nhamo (2015). Wong et al., (2016) concur that inadequate information exchange amongst building firms and sellers, as well as weak market need for reclaimable building materials, obstructs the growth of green procurement.

To eliminate this obstacle, Testa et al., (2014) recommend that effort be exerted to disseminate information on green procurement, irrespective of blocks and limitations. Wong et al., (2016) affirm that information on the environmental and economic advantages associated with green design ought to be made available so as to inspire customers to utilise energy efficient and green construction methods and designs. Information provision is critical between customers, sellers and suppliers in order to improve adoption.

2.4.5 Education and training

According to Muraguri et al., (2015), policies are sometimes introduced but no training is conducted to support implementation. Lack of training may result in poor interpretation of policies, thus perpetuating hindrances. Agyepong and Nhamo (2015) concur that the main decision-making officers are not competent on the application, appraisal and monitoring of green procurement. Ahsan and Rahman (2017) affirm that

the absence of training in support of public procurement staff is the single greatest obstacle to the execution of green procurement. Athapaththu and Karunasena (2018) concur that most corporations do not want to educate and train their personnel on sustainable construction methods.

To conquer this obstacle, efforts must be made by organisations to train the green procurement team, especially the supply chain staff and line managers (Urban Seed, 2012). Investing in education and training will ensure that staff is acquainted with green approaches and that clients receive value for money in their purchases. Training is required in support of public procurement staff to improve their current skills and capabilities in order to develop new approaches and mindsets (Ahsan & Rahman 2017; Wong et al., 2016; Agyepong & Nhamo, 2015). Moronge and Zawadi (2018) also point out the need for employees to be skilled and knowledgeable with regard to sustainability practices. Training should also be extended to other internal stakeholders involved in the supply chain network.

2.4.6 Inadequate organisational resources and inadequate political or management backing

Testa et al., (2014) state that among the main obstacles to green procurement are inadequate organisational resources and lack of political support. Wyawahare and Udawatta (2017) mention that inadequate support from managers is an internal barrier to successful GSCM implementation in construction organisations. Niemann et al. (2016) cite the absence of managerial support as a significant barrier to effective application of GSCM because of the high level of influence top managers have; their disinterest translates as company-wide disinterest. Moronge and Zawadi (2018) also state that the barrier to adopting green procurement in Zimbabwe is lack of management support

Overcoming this barrier would requires education and conscientizing of top management (Wessels, n.d.), since change in municipalities and many other organisations starts at the top. Raman (2014) states that a key factor for realising GSCM is the backing and commitment from highly ranked bosses. Wong et al., (2016) observe that pressure inside the firm or organisation, mainly from top management, would compel junior staff to execute green procurement. Companies or state

organisations might also establish departments or units that specialise in environmental issues in support of green procurement. Top management should ensure that roles are clear and assign responsibilities within departments that support green procurement.

2.4.7 Unavailability of sustainable products or services

Wong et al., (2016) state that there are insufficient suppliers of comprehensively green services and products, which limits options for parties responsible for comparing tenders and making choices. This barrier ought to be a serious concern for designers in developing countries, since aware designers may wish to specify green products and services but cannot if the market is not ready to supply. Wessels (n.d) established that green products are unavailable in developing countries since local distributors do not stock such or stock them only in small quantities. In many cases green products are not obtainable in domestic or industrial marketplaces (Ahsan & Rahman, 2017; Mewomo et al., 2017; Moronge & Zawadi, 2018).

Growing market demand would assist in overcoming this obstacle (Wessels, n.d). Introducing a perfectly operational green material marketplace would aid in the promotion of green procurement (Wong et al., 2016). According to Urban Seed (2012), when dealing with the unavailability of resource-efficient products and services, an organisation ought to alert its suppliers and talk to them about their green procurement goals. In this way much could be achieved. Government departments have tremendous buying power and their specific input on this matter to suppliers could yield significant results (Ibid).

2.4.8 Lack of 'green' experts

Raman (2014) states that challenges associated with GSCM includes a lack of green professionals (architects, consultants, green developers and contractors) resulting in rejection of the concept. This barrier seems applicable mostly in developing countries, including South Africa. Balasubramanian and Shukla (2017) highlight the absence of trained employees with a comprehensive understanding of eco-friendly approaches as an internal barrier. Properly trained human resources would include all stakeholders in the supply chain such as project managers, supply chain officials and professionals

within the client organisation responsible for the approval of external consultants' designs. Athapaththu and Karunasena (2018) affirm that a shortage of expertise in support of sustainable construction and a generally poor understating of sustainable aspects remains a barrier to green procurement.

In resolving this issue, Bohari et al., (2017) point out that it is important to begin with early teaching as part of the school syllabus in order to promote awareness of environmental issues. Organisations intending to implement green practices could use experienced companies or knowledgeable local professionals from developed countries for skills transfer purposes. Training providers ought to roll out short training courses for attendance by stakeholders involved green practices, and public organisations should encourage attendance.

2.4.9 Lack of customer awareness

Challenges associated with GSCM includes lack of customer awareness of GSCM (Raman, 2014; Wong et al., 2016; Wyawahare & Udawatta, 2017). A study by Kiggundu (2014) highlights the barriers of green practices within construction industry and cites lack of consumer awareness of green purchasing tools and initiatives. The absence of stakeholders' awareness is a key difficulty for green procurement implementation (Moronge & Zawadi, 2018; Athapaththu & Karunasena, 2018; Ruparathna & Hewage, 2015).

In order to overcome this barrier, Testa et al., (2014) argue that the appropriate approach is for those who are aware of the value of green procurement to make a constant effort to spread awareness. Increased awareness may be effected through television, roadshows and/or social media platforms. Raising awareness not just of the broad concepts but of the importance of purchasing decisions could make green procurement more mainstream (Bohari et al., 2017). The authors further state that awareness is vital for green procurement adoption, that it should be experienced first by individuals and then extended to organsiations and government departments and their project teams. Explicit knowledge tends to be shared less than tacit knowledge (Moronge & Zawadi, 2018).

2.4.10 Non-existence of green procurement guidelines, regulations and policies

Legislation is the power behind the implementation of green procurement (Ahsan & Rahman, 2017). Lack of adequate legislation is a serious barrier. Muraguri et al., (2015) aver that if businesses were required by law to act in ways that are ecologically sound, they would be forced to scrutinise their value chains and exert the necessary effort to comply with regulations. Bangladesh is an emerging country where very limited GSCM practices exist in the construction industry owing to an absence of legislation (Chowdhury et al., n.d.). Most researchers concur that one of the key barriers to green procurement is the non-existence of sustainable procurement regulations, policies and guidelines (Yu et al., 2018; Niemann et al., 2016; Agyepong & Nhamo, 2015).

Several authors urge for tighter legislation on green procurement, which can only be fulfilled by governments. Ahsan and Rahman (2017) point out that the UK government played a dominant role in enforcing GPP application through the enactment of several pieces of legislation. According to Ahsan and Rahman (2017), many earlier studies indicate that the establishment of a GPP agenda in advanced countries was made achievable by the enactment of legislation and specific regulations. In addition to government legislation, Moronge and Zawadi (2018) state that organisations must develop their own green procurement policies to support specific actions and discourage others. Moreover, they should strive to be familiar with the green needs of the public and the green credibility of their suppliers.

2.4.11 Difficulties with differentiating between products

Emuze et al., (2015) states that a barrier to green pocuremnt includes a lack of knowledge of materials and selection from very limited materials. Moronge and Zawadi (2018) assert that one of the challenges to green purchasing lies in the difficulty of differentiating between environmentally preferable products and other products.

Some countries have developed systems to assist buyers in identifying non-green products and services in order to overcome this barrier. Eco-labelling schemes offer guiding principles as well as sensitisation to assist consumers with selecting eco-

friendly goods and services (Bohari et al., 2017). Moronge and Zawadi (2018) aver that eco-labelling is a method for identifying green products and their positions. Eco-labelling assists consumers to distinguish environmentally preferable products from non-green products. Wessels (n.d.) states that Environment Canada established an intranet-based electronic green products database called EcoNexus™ so as to create environmentally responsible procuring decisions. Product specifications ought to highlight how environmentally friendly the product is.

2.4.12 Lack of financial resources for initial costs

Niemann et al., (2016) state that initial costs needed for many eco-friendly projects are a barrier to GSCM. Costs can also be a barrier to corporations during the execution of green supply chains because of the need to initiate numerous green practices simultaneously; for instance, green fabricating, green design, green branding and packaging, and the costs associated with cutting edge technologies, employment, training and motivation of high-quality workers. Difficulties with the acceptance of sustainable approaches include the lack of adequate budget allocations (Agyepong & Nhamo, 2015; Ruparathna & Hewage, 2015; Balasubramanian & Shukla, 2017). Implementing greener approaches may also slow down production rates and revenue as workers adapt; therefore, sufficient financial resources are critical, especially during the initial stages.

For overcoming this obstacle, Urban Seed (2012) recommends that organisations considering green procurement identify pilot projects to start with or take a phased-in approach, since they are more likely to succeed with this approach than with a sudden, comprehensive overhaul of methods and suppliers. Dedicated budgets must be made available to implement green procurement projects (Agyepong & Nhamo, 2015). Ahsan and Rahman (2017) state that it is important for organisations to make available the necessary capital to fund sustainable purchasing that will be economically advantageous in the end. Oke et al., (2019) affirm that governments should provide financial assistance by way of tax inducements and subsidies for building companies, as well as pre-tax loans, deficit backings and financial rebates.

2.4.13 Technology

Inadequate technology is listed as a barrier to green procurement by Niemann et al., (2016). The authors argue that effective information and technology approaches are of great importance for successful GSCM through all phases of product lifespan. Wyawahare and Udawatta (2017) stress the lack of government backing for the adoption of new techniques as a common barrier. Aigbavboa, Ohiomah and Zwanea (2017) concur that the absence of resources to invest in the advancement of technology is an additional difficulty confronted by the building sector, since they carry the risk that substantial investments in technologies may financially crippling. A lack of examples of green projects could exacerbate this doubt and uncertainty with regard to investing in appropriate technology.

In order to overcome this barrier, construction companies ought to envisage future developments in their field so as to avoid being left behind. There is a constant need to innovate and adapt to rapidly changing technologies and methods. Wong et al. (2016) state that numerous aspects are considered by firms when determining whether or not to adopt green procurement; for instance, accessibility, or the presence of sophisticated green technology for construction objectives. The authors further state that wider acceptance of Building Information Modelling (BIM) ought to be pushed by the State to inspire appropriate design and construction and to reduce construction debris. Many organisations are mindful of green construction techniques and have by now incorporated certain green approaches such as using recycled materials, reducing waste, striving for energy and water savings, maintaining cost efficiency and implementing less intrusive and destructive practices (Athapaththu & Karunasena, 2018).

2.4.14 Supplier dishonesty

Ahsan and Rahman (2017) maintain that some corporations identify green preferences in their purchasing policy documentation, but their activities fall far short of their claims. This boils down to dishonesty. Moronge and Zawadi (2018) affirm that some manufacturers use 'green washing' techniques, which is the act of deceiving

customers about green environmental practices and the green paybacks related to a service or product.

To discourage dishonest behaviour, suppliers ought to be requested to make available the environmental specifications of their products and methods so as to deal with the challenge of lack of green specifications often supplied (Urban Seed, 2012). Legislation should be established to punish dishonest suppliers through heavy taxes, fines or imprisonment, or through boycotts of their products.

2.4.15 Lack of co-operation and/or communication

Bangladesh is an emerging country where very limited GSCM exists in the construction industry owing to the non-existence of co-operation and coordination (Chowdhury et al., n.d). Lack of co-operation and/or communication is an internal barrier associated with unsuccessful GSCM implementation in construction companies (Wyawahare & Udawatta, 2017). Balasubramanian and Shukla (2017) concur that external green barriers include lack of co-operation amongst stakeholders.

In order to dismantle this barrier, Moronge and Zawadi (2018) assert that product suppliers and designers should collaborate to reduce poor designs and methods that are fast falling out of favour with conscious consumers. Wong et al., (2016) state that collaboration amongst designers and other participants in the building value chain is a basis for the effective evolution of sustainable construction.

The literature affirms that co-operation and stakeholder participation is critical for successful green implementation. A shared commitment and joint effort with regard to the goals and practice of green procurement is key to overcoming the lack of cooperation that currently hampers green procurement.

Several barriers for GP implementation and related mitigations strategies were outlined in this section of the study. The next section will profile the benefits of practising GP.

2.5 The benefits of practicing green procurement

This section reviews the benefits associated with practising green procurement in the public sector. Both sectors – public and private – benefit from green procurement, but it is the public sector which forms the scope of this study. For the purpose of this study, the benefits associated with GP implementation serves as the positive impacts or paybacks gained.

2.5.1 Government level

Green procurement is an unfamiliar concept in developing countries, remaining largely unexploited. This is unfortunate, given the many benefits that green procurement can confer on governments. (Wessels, n.d). Moronge and Zawadi (2018) state that the South African government is currently realising some of the paybacks associated with green procurement, including a reduction in costs through lowered power utilisation and more efficient management of resources. ‘Green’ products tend to last longer; for example, energy saving lightbulbs last longer than non-energy saving light bulbs and help reduce the consumption of energy and materials.

Agyepong and Nhamo (2015) argue that green procurement practice can help South Africa to accomplish its international and national obligations with regard to sustainable development and climate change. These authors also point out that green procurement has the potential to create work opportunities and improve the quality of life for citizens. Another benefit is that it enables South Africa to fulfil the pledge made by certain South African metropolitan municipalities at the World Conference on Sustainable Development (WSSD) in 2002 to follow certain approaches with regards sustainable procurement (Urban Seed, 2012).

2.5.2 Environment

The overall objective of green procurement is to change the consumption and production patterns of products and services so that they become more environmentally friendly (Bohari & Xia, 2015). Agyepong and Nhamo (2016) assert that green procurement is closely associated with the safety of the environment in neighbourhoods. For this reason, communities ought to be involved in the production

of green materials. This would obviate the need for transportation across long distances, which is in itself an unsound practice for environmental protection.

Kiggundu (2014) argues that green procurement offers a solution for managing the environmental difficulties associated with construction projects, enabling an integration of environmental criteria into products from inception to their end of life. Minimising the environmental damage of construction projects requires meaningful stakeholder participation and the involvement of local suppliers and local communities. Chowdhury et al., (n.d) argue that the application of GSCM increases energy efficiency, decreases the emission of GHG, and salvages environmental resources through reducing waste. Wyawahare and Udawatta (2017) uphold that green practices help to minimise waste generation, increase environmental performance, and enhance cost effectiveness and organisational skills. Wessels (n.d) lists a number of environmental benefits of green procurement, including human health and safety through the proper management of waste and injurious materials and a lower need for landfill areas.

Wong et al., (2016) concludes that the main benefits attributed to green procurement in the field of building projects are environmental and economic.

2.5.3 Economic

Niemannn et al., (2016) identify many economic advantages associated with GSCM which some organisations still fail to see. Wessels (n.d.) mentions the cost savings that are made possible through the purchasing of goods which can be recycled or refitted, and savings made in water, energy and fuel. Such savings inevitably bring down the costs of projects.

Moronge and Zawadi (2018) assert that several firms are realising that a supply chain that embraces environmental concerns is beneficial not only for the environment but for the business. The returns associated along with green procurement are not restricted to environmental but are also social and economic in a nature (Bohari & Xia, 2015). These authors point to the triple bottom line of sustainability – environmental, economic and social – all of which must be borne in mind from the design stage to the end of the life of a project.

Moronge and Zawadi (2018) concur that organisations practising green procurement are likely to reap both quantitative and qualitative paybacks. Dadhich et al., (2014) state that the British government is confident in the economic value of green procurement, given that green expansion policies result in longer periods of enhancement of economic prosperity and welfare.

Wong et al., (2016) state that green procurement can bring about potential improvements in supply chain links and reduced transactional prices, emissions and risks. The improvements associated with green procurement include enhanced skills and knowledge of staff, local supplier awareness and job creation. Training providers could take advantage of opportunities presented by green procurement and offer related courses to government staff and the private sector.

Businesses that make the decision to 'go green' not only make increased profits in the long run but aid in protecting the ecosystem and minimising the damaging environmental impacts of their operations (Raman, 2014). Niemann et al., (2016) state that GSCM implementation can enhance the reputation and image of the organisation, which can have economic benefits for a company. Roehrich, Hoejmose and Overland (2017) uphold that GSCM is a significant tactic for corporations intending to achieve several paybacks, including both reputational and economic.

Urban Seed (2012) argues that the purchase of ecologically preferable commodities reduces waste administration payments and the expenses related to contaminant treatments. South African landfill sites are overwhelmed with waste such as construction rubble, much of which are not recyclable. Green products and services can reduce the waste transfer fees charged by municipalities for dumping, and also promote recycling. The municipalities themselves would also be relieved of some of the costs of running landfill sites, and could use such savings to deliver other services.

2.5.4 Social

Akadiri et al., (2012) affirm that amongst the benefits of sustainable building is the positive contribution to a healthier living standard, operational efficacy and healthy working surroundings. The authors state further that sustainability improves the quality of life of all, allowing communities to dwell in healthy surroundings and enhancing economic, social and ecological aspects of life. Wong et al., (2016) state that

implementing green procurement reduces harmful effects on communities adjacent to construction projects. The public can also take advantage of recycled waste and thereby both generate an income and assist in lowering the carbon footprint of the surroundings.

Several short-term and permanent jobs were created through the Gautrain and BRTs in South African metropolitans. Bus drivers and support staff were hired to service Gautrain and the BRTs. The public also benefitted from lowered traffic congestion and slower deterioration of roads in metropolitans where these systems were implemented. Table 2.3 summarises the benefits of practising green procurement.

Table 2.3: The benefits of green procurement

Description	The benefits of green procurement
Government level (national, provincial and municipal)	(1) Reduction of costs through reduced use of power and resources, and proper management and reuse of materials. (2) Fulfilment of a pledge made by certain South African metropolitan municipalities at the World Conference on Sustainable Development (WSSD) in 2002 to follow approaches that promote sustainable procurement (Urban Seed, 2012). (3) Potential improvements to supply chain links. (4) Reduction in waste management fees. (5) Decreases in GHG emissions, salvaging of environmental resources through reduced waste and lower need for landfill sites.
Environmental	(1) Offers a solution for managing the environmental difficulties caused by construction projects, in that environmental criteria are integrated into the product from inception to end of life. (2) Objectives are to change the consumption and production patterns of products and services, enabling them to become more environmentally friendly. (3) Promotes the safety of environments within neighbourhoods, and affords neighbourhoods opportunities to get involved in manufacture and recycling. (4) Reduces environmental risks and achieves financial benefits.

	(5) Enhances financial as well as environmental performance of building projects. (6) Application of GSCM decreases GHG emissions and promotes salvaging of environmental resources through lowering waste. (7) Minimises waste generation, increases environmental performance, enhance cost effectiveness and organisational skills. (8) Results in reduced costs due to effective management of waste and injurious materials, a reduced need for landfill sites, and savings made through the purchasing of goods which can be recycled or refitted. Savings are also made through devices which use less water, energy and fuel.
Economic	(1) Reaps qualitative and quantitative paybacks. (2) Potentially improves supply chain links. (3) Supply chains which include environmental concerns are good not just for the environment but for the business. (4) Green procurement can bring about potential improvements to supply chain links, reducing transactional prices, emissions and risks. (5) Businesses that 'go green' will not only make increased profits in the long run but will also aid in protecting the ecosystem and reduce negative impacts on the environment. (6) GSCM implementation can enhance the reputation and image of the organisation. (7) GSCM is a significant tactic for companies intending to achieve several paybacks. (8) The purchase of ecologically sound commodities is capable of reducing waste administration payments and expenses related to the treatment of contaminants.
Social	(1) Sustainable building practices lead to healthier living standards, operational efficacy and healthy working surroundings. (2) Improving the quality of life of all, allowing people to dwell in healthy surroundings with enhanced economic, social and ecological aspects. (3) Green procurement lowers the negative effects of projects on adjacent communities. (4) Creates upskilling and employment opportunities.

This chapter has presented a comprehensive review of aspects of green procurement according to a diverse range of researchers on several continents. A brief summary of the findings follows.

2.6 Chapter summary

The key objectives of this chapter were to investigate the extent of green procurement in various countries and to identify both the drivers and the barriers to green procurement practice. The review enabled the researcher to identify gaps in the literature which the survey portion of this study hopes to fill. The literature review also helped shape and refine the research problem in order to establish the research objective. The chapter examined the concept of green procurement in several countries in order to craft a context in respect of examination of green procurement in South Africa. It concluded with a discussion of the multi-faceted benefits of green procurement.

Green procurement in Africa and South Africa is relatively new in relation to Europe and the US, where it has been practised for decades. “The public sector in South Africa is a dominant client as well as initiator of projects and that one might reasonably expect alignment between national legislation and NDPW practice”. Owing to a lack of cohesive and comprehensive legislation on green procurement, the public sector in South Africa uses a mixture of legislation to guide policy. The Carbon Tax Act No 15 of 2019 (effective on 01 June 2019) establishes a fine for excessive greenhouse gas emissions and resulted in an increase in fuel prices in June 2019, with the price hike intended to lower carbon emissions. This law aims to alter consumer behaviour indirectly, in that it stimulates the use of public transport and lift clubs, and in so doing may help to foster a ‘low carbon’ society. Despite this and other laws, and some progress in the area of lowering emissions, there is still much to be attained in reducing South Africa’s greenhouse gas emissions, according to Mewomo et al., (2017).

Most metropolitan municipalities in South Africa are at a fairly advanced stage of practising green procurement, despite lacking a specific green procurement policy. It is interesting that these larger municipalities did not wait until a green policy compelled

their actions, but have seemingly understood the urgency of the climate crisis and are pursuing mitigation projects and purchasing environmentally-friendly products and services where possible.

Raman (2014) affirms that when green procurement is made a priority, there are positive public relations spinoffs for government departments and companies. Despite this commercial benefit, many countries lag in the area of environmental awareness and practice. Green procurement in the developed states of North and South America, Europe, Asia and Oceania have been practising green procurement for almost three decades in some cases, mostly because these countries have promulgated legislation compelling such actions. In addition, many government departments and companies have specific policies dealing with green procurement.

The literature revealed 13 green procurement drivers or enablers. Many were linked to government actions, which confirms that governments are the key drivers of green or sustainable procurement.

Most of the other African countries studied – Kenya, Zimbabwe, Ghana, Nigeria and Zambia – are lagging in the practice of green procurement, mainly in the public sector, since green procurement laws are non-existent. However, in some countries efforts are being made to introduce policies and laws related to environmental protection and, in some cases, green procurement. Where this happens, it is largely thanks to the dedication of pressure groups or environmental NGOs, which play a crucial role in shaping public opinion and pressuring both the public and private sector to ‘go green’. It was found that in Africa the private sector is more committed to green procurement than the public sector. African countries are mostly ‘emerging’ and environmental concerns are often overshadowed by poverty and corruption. These countries would benefit by partnering with and learning from bodies in developed countries.

The application of green ideas is confronted with plenty of challenges (Mewomo et al., 2017), in both South Africa and developed countries, but dedicated professionals and activists continued to pursue the green concept. A total of 15 barriers obstructing public sector implementation of green procurement were revealed in the literature, each with its own suggested solutions. Any organisation intending to employ green or sustainable practices has to overcome or weaken most of the barriers highlighted, as well as others not mentioned here that depend on location and sector. A review of the

barriers and their proposed solutions would provide a yardstick for companies preparing to embark on more responsible procurement, and raise their awareness of the pitfalls and challenges likely to be encountered.

A research gap was highlighted by Mewomo et al., (2017), who stated that past surveys relating to 'green' expansion in South Africa show the deplorable state of green implementation, even in the presence of laws and policies. Balasubramanian and Shukla (2017) confirmed this gap, which led to the decision to investigate the extent of green procurement practice by designers at the design stage of public sector projects, focusing on the National Department of Public Works, South Africa. Balasubramanian and Shukla (2017) pointed out that limited studies have been conducted on the integration of environmental issues into the design stage of public sector projects.

Thus, this study sought to investigate the extent to which designers appointed as consultants (i.e. external service providers) practise green procurement at the design stage of public sector projects, with a focus on the National Department of Public Works in South Africa.

The practice of green procurement yields several benefits, not only for the environment but for public health and safety, and for the bottom line of companies and government departments seeking cost savings. Firms may benefit from increased work opportunities in government departments (national, provincial and municipal) due to being seen as sound and ethical, and thus satisfying the demands of public opinion.

Government at national and municipal level ought to take advantage of the obvious paybacks presented by green procurement, so as to protect the environment for current and future citizens and ensure their own longevity. Costs saved by government from lowered energy use and water use could be used to deliver more services to the public. Although government is not a 'for-profit' organisation, a green supply chain would help sustain its tax revenues and help it fulfil its service delivery mandate.

The following chapter discusses the research design exploited in the course of data collection for the survey portion in this study.

CHAPTER THREE: RESEARCH DESIGN

3.1 Introduction

This section of the study explains the research process followed for gathering data so as to tackle the research question and achieve the research objectives. The research was carried out in the field of green procurement practice at the design stage of construction projects in the public sector.

The survey aimed to establish the extent of green procurement practice by external designers at the design stage of construction projects in the public sector. It probed participants' thoughts on existing policies, legislation and regulations that enable green procurement, and the major barriers to green procurement experienced by designers at the design stage of projects. The uncovering of these facts, it was envisaged, would help to either confirm or refute the findings from the literature, as far as they apply to construction projects in the South African public sector.

This chapter describes the research methodology applied in line with Saunders's research onion framework for conducting a research. It begins with a recap of study's research problem and question, then illustrate the research philosophy, approach to theory development, methodological choice, research strategies, time horizon, Questionnaire design, data collection and analysis. It concludes with a discussion of the study's ethical aspects considered in conducting the research.

3.2 Research problem and research question

Countless research papers have been conducted globally in the field of green procurement, but there are insufficient studies on green procurement at the design stage of construction projects. Since 1987, in the history of the world when sustainability took a centre stage, people started incorporating sustainability principles into the way they procure projects. First, it started with the design stage. Khaled, Kashkool and Mohammed (2016) state that in order to achieve sustainable performance in the construction industry, the application of sustainable construction criteria and tools must be started as early as planning and design phases of any

construction project. Othman & Abdelwahab (2017) concur that it is necessary to integrate sustainability concepts from the very beginning of any project to ensure the successful delivery of sustainable projects.

Later on, around year 2002, with the rise of sustainability, people started talking about incorporating sustainability also at later stages because even after design sometimes during implementation people revert back to unsustainable things or ways. During the 2002 World Summit on Sustainable Development, held in Johannesburg, South Africa; a proposal was made to utilize green or sustainable procurement as a move to tackle environmental concerns (Ruparathna & Hewage, 2015; Agyepong & Nhamo, 2016). Pacheco-Blanco and Bastante-Ceca (2016) avow that the GPP concept originated in Chapter III of the Plan of Implementation of the Johannesburg Summit, which encouraged the relevant authorities at all levels “to take sustainable development considerations into account in decision making, including public procurement”.

So, with the development of new procurement approaches or new contractor approaches, people started talking on how to incorporate sustainability thinking across all stages. Therefore, with the advent of more integration by implementation of integrated procurement being, there is more room or talk about implementing green throughout the project lifecycle. Now we even talk about green facility management.

The research question was therefore raised: To what extent is green procurement practised by designers, in particular engineers and architects, at the design stage of construction projects within the public sector.

The study is founded on data collected from the sampled population of built environment designers through a questionnaire. A research methodology was developed so as to answer the aforesaid research question.

3.3 Research methodology followed

Saunders et al., (2016) state that an approach for using a research onion framework is to start from the outer layer (philosophy) to the inner layer (data collection & data analysis) as illustrated below.

3.3.1 Research philosophy

The exterior layer of a research onion, is the research philosophy which prepares the ground for the research process. Kiggundu (2014) describes the research philosophy as the knowledge that underpins the study and the assumptions made by the researcher that subsequently influence the way in which he or she views the research. Saunders et al., (2016) state that the research philosophy is about a system of suppositions and beliefs around knowledge development.

Saunders et al., (2016) aver that there are three key research assumptions; Ontology, Epistemology and Axiology which are vital in the research process to distinguish research philosophies. Al-Saadi (2014) state that, Ontology is concerned with our beliefs about the kind and nature of reality and the social world (what exists). Saunders et al., (2016) concurs that Ontology refers to assumptions about the nature of reality. Epistemology is about the assumptions which one makes about “the very bases of knowledge – its nature and form, how it can be acquired and how it can be communicated to other human beings” (Al-Saadi, 2014). Saunders et al., (2016) affirms that Epistemology is an assumption concerned with knowledge, what constitutes acceptable, valid and legitimate knowledge and how the knowledge should be communicated to others. Axiology refers to the role of values and ethics within the research process. Therefore, Epistemological assumption is relevant for this study because it is concerned with amassing knowledge in the field of green procurement practised by designers, in particular engineers and architects, at the design stage of construction projects within the public sector. Kiggundu (2014) note various kinds of research philosophies – pragmatism, objectivism, subjectivism, positivism, realism and interpretivism. Saunders et al., (2016) clarifies the following five major research philosophies; positivism, critical realism, post-modernism, pragmatism and interpretivism.

Positivist try to remain neutral and detached from your research and data in order to avoid influencing your findings. They claim to be external to the process of data collection as there is little that can be done to alter the substance of the data collected. In the Internet questionnaire, the researcher determines the list of possible responses as part of the design process. Subsequent to this she or he can claim that her or his values do not influence the answers given by the respondent.

Critical realism focuses on explaining what we see and experience, in terms of the underlying structures of reality that shape the observable events. Critical realist research focuses on providing an explanation for observable organisational events by looking for the underlying causes and mechanisms through which deep social structures shape everyday organisational life. Due to this focus, much of critical realist research takes the form of in-depth historical analysis of social and organisational structures, and how they have changed over time. Within their focus on the historical analysis of structures, critical realists embrace epistemological relativism, a (mildly) subjectivist approach to knowledge. Critical realist researcher, strive to be aware of the ways in which socio-cultural background and experiences might influence research, and would seek to minimise such biases and be as objective as possible. Critical realist researcher minimises biases and strive to be objective as possible. But the fact that it employs observation, takes the form of in-depth historical analysis, therefore it becomes inappropriate for this study.

Postmodernists go even further than interpretivists in their critique of positivism and objectivism, attributing even more importance to the role of language. Postmodernists strive to make what has been left out or excluded more visible by the deconstruction of what counts as 'reality' into ideologies and power relations that underpin it, as you would dismantle an old building into the bricks and mortar that make it up. The goal of postmodern research is therefore to radically challenge the established ways of thinking and knowing and to give voice and legitimacy to the suppressed and marginalised ways of seeing and knowing that have been previously excluded. As a postmodernist, you would be open to the deconstruction of any forms of data – texts, images, conversations, voices and numbers. Since post-modernism strives to expose the excluded, it would have been suitable for this study. However, because it is open to deconstruction makes it unsuitable. This study acknowledges literature in the field of green procurement at the design stage of construction projects and does not intends to undertake deconstruction rather contribute on existing knowledge. Pragmatism strives to reconcile both objectivism and subjectivism, facts and values, accurate and rigorous knowledge and different contextualised experiences. It does this by considering theories, concepts, ideas, hypotheses and research findings not in an abstract form, but in terms of the roles they play as instruments of thought and action, and in terms of their practical consequences in specific contexts. Pragmatists

recognise that there are many different ways of interpreting the world and undertaking research, that no single point of view can ever give the entire picture and that there may be multiple realities. This does not mean that pragmatists always use multiple methods; rather they use the method or methods that enable credible, well founded, reliable and relevant data to be collected that advance the research. Pragmatism philosophy considers hypotheses and sometimes multiple methods when conducting a research, therefore unsuited for this study. This study does not employ hypotheses and or multiple methods for data collection.

Interpretivism like critical realism, developed as a critique of positivism but from a subjectivist perspective, emphasising that humans are different from physical phenomena because they create meanings. The purpose of interpretivist research is to create new, richer understandings and interpretations of social worlds and contexts. Interpretivist researchers try to take account of this complexity by collecting what is meaningful to their research participants. Crucial to the interpretivist philosophy is that the researcher has to adopt an empathetic stance. The challenge for the interpretivist is to enter the social world of the research participants and understand that world from their point of view. In concluding the appropriate research philosophy for this study, an assessment was carried out on the various philosophies cited and deliberated above resulting in adoption of interpretivism. The purpose of interpretivist research is to create new, richer understandings and interpretations of social worlds and contexts (Saunders et al., 2016). This exploratory study strives to build-up on the limited knowledge in green procurement at the design stage of projects in the public sector. Edirisingha (2012) note that the goal of interpretivist research is to understand and interpret the meanings in human behaviour rather than to generalize and predict causes and effects.

3.3.2 Research approach to theory development,

The literature reveals that there are three types of research approach; deductive, inductive and abductive (Saunders et al., 2016). Solanke (2015) asserts that with the deductive approach, hypotheses are generated from a general truth or statement in order to accomplish a definite decision. Research starting with theory development

through a review of publications and subsequently designing a strategy to test the theory may be described as deductive in nature (Saunders et al., 2016).

In this research, a deductive approach was adopted in theory development through an extensive review of the literature and laid the groundwork for data collection. The literature was reviewed so as to gain knowledge around the research problem and to help with the development of a questionnaire for the study.

Inductive is the opposite of the deductive approach (Saunders et al., 2016). Agyepong (2014) describes the inductive approach as a 'bottom up' approach.

3.3.3 Research design and methods (methodological choice)

Research methodology is the plan and step-by-step procedure for conducting a research (Agyepong, 2014; Solanke, 2015).

The three categories of research design; mixed method, qualitative and the quantitative (Agyepong, 2014; Saunders et al., 2016). The quantitative method is the collection and presentation of numerical data, often based on a questionnaire (Saunders et al., 2016). The qualitative method involves the collection of non-numerical data which may be based on a questionnaire, interviews or observations. Agyepong (2014) states that the mixed method research design utilises the two categories, quantitative and qualitative data.

The study adopted a deductive (top down) approach as this approach is suited to quantitative research, where a literature review precedes data collection (Saunders et al., 2016). The enquiry began with a broad literature review so as to explore concepts in the field of green procurement at the design stage of projects according to other scholars (Abbasi, 2017; Wong et al., 2016). The review of literature laid a good foundation for the development of the research problem and research question. The literature review assisted in the crafting of a structured questionnaire survey using Qualtrics software.

Saunders et al., (2016) note that a quantitative research design may use a single data collection technique such as questionnaire, and corresponding quantitative analytical procedure known as mono method quantitative study. A mono method uses a single

data collection technique and a corresponding analysis procedure. This study embraced a mono method quantitative approach for data collection using an online survey, consistent with an exploratory research by Barros-Justoa, Oliviera and Pincirolib (2018). These authors conducted an exploratory study using an online survey, based on at least the following reasons: a low investigation cost and most importantly, the ease of replication.

A study by Barros-Justoa, Oliviera and Pincirolib (2018) is used as a baseline to conduct an exploratory study in green procurement practised by designers, at the design stage of construction projects within the public sector. This study desired to conduct a type of baseline study, since this is new research, to determine the basis for more in-depth studies. However, the researcher aspired to achieve as much reach as possible within the time frame. Pacheco-Blanco and Bastante-Ceca (2016) assert that an exploratory approach can be seen as a guide to establish a data collection framework, and it is particularly suited for research areas having little prior theoretical literature or in cases when empirical research is not available.

3.3.4 Research strategies

Kiggundu (2014) describes research strategy as the plan of action for how a scholar intends to go about answering their research question. Saunders et al., (2016) affirm that research strategy is the overall plan of the scholar that enables him or her respond to the research question. The authors clarify further that, research strategy is the methodological link between philosophy and subsequent choice of methods to collect and analyse data.

Different types of research strategies exist, discussed in a study by Kiggundu (2014) and confirmed by Saunders et al., (2016) as: case study, the experiment, the survey, action research, grounded theory, the archival research, the narrative inquiry and ethnography. Saunders et al., (2016) illustrate these various research strategies below using a research onion framework.

Case study

This strategy involves an in-depth inquiry into a topic or phenomenon within its real-life setting. Case study is relevant for deeper investigation into a thing, person, or

group over a period of time (Ozumba & Aduda, 2015). Case study strategy is therefore not appropriate because of limited time to conclude this research.

Experiment

Its roots are in natural science as well as laboratory-based research. The strategy uses hypotheses rather than research question, therefore not suitable for this study.

Survey

The survey strategy is typically linked with a deductive research approach and used mostly on exploratory studies. Survey strategies generally use questionnaire therefore allowing collection of standardised data from a sizeable population in a highly economical way permitting easy comparison. Survey strategy is therefore adopted because this study embraced a deductive research approach, it is an exploratory and used a questionnaire for collection of standardised data in a cost-effective manner.

Action research

This strategy is an emergent and iterative process of investigation, designed to develop solutions to real organizational problems through a participative and collaborative approach, which uses different forms of knowledge, and which will have implications for participants and the organization beyond the research project. Action research strategy does not fit in this study because of its iterative process of inquiry and implications to respondents beyond research.

Grounded theory

This strategy provides a systematic approach to collect and analyse data qualitative data. Again, its use is often well suited to the nature of qualitative research. Grounded theory employs inductive approach. This strategy is unsuitable as it is mostly used in qualitative research, utilizes inductive approach to data collection as opposed to deductive approach used by this study.

Archival research

Limitations to internal documentary sources is a disadvantage for using this strategy. Some organizations tend to refuse access to certain internal documents since such were not created for research purposes. Then, if access is granted, you may find that some data are restricted for confidentiality reasons. This strategy did not succeed in this research, since documentary sources relating to green procurement, policy, legislation and regulations were not provided by the NDPW, hence only a questionnaire was utilised.

Ethnography

Is used to study the culture or social world of a group and as well qualitative research strategy. Therefore, this strategy is unsuitable for a study investigating green procurement practise by designers, in particular engineers and architects, at the design stage of construction projects within the public sector. No culture is studied in this research.

Narrative inquiry

This strategy is linked to storytelling and involves qualitative research interview. Therefore, unfit for a quantitative study because of no interviews or storytelling is taking place.

In determining the appropriate research strategy for this study, an analysis was conducted on the various strategies mentioned and discussed above resulting in adoption of a Survey strategy. Creswell (2014) avow that, there is rationale for using a survey as the preferred type of data collection procedure: the advantages such as the economy of the design and the rapid turnaround in data collection and given the cross-sectional time horizon. This enquiry opted for the Survey strategy of design professionals who work as consultants to the NDPW across their 11 Regional offices as an exploratory study. Survey strategy is therefore adopted because it embraces a deductive research approach, applicable on exploratory studies and used on questionnaire for collection of standardised data in a cost-effective manner.

3.3.5 Time horizon

Omotayo and Kulatunga (2015) assert that there are two major time horizons for a research being longitudinal and cross-sectional. Cross-sectional time is relevant for a research with objectives to be resolved within a shorter time whilst longitudinal time horizon involves several months of data collection. Saunders et al., (2016) affirms the two major time horizons. This study conforms to cross-sectional time horizon, given that it was time bound due to insufficient time available.

3.4 Questionnaire design, data collection method and analysis

Questionnaire design

Ekinci (2015) state that the fundamental purpose of a questionnaire is to collect reliable and valid information from respondents. A questionnaire, being a widely used data collection method was developed as an instrument for this mono method quantitative study following review of literature in green procurement practice at the design stage of construction projects. The survey questionnaire was designed with a Qualtrics online survey and analytics software. The survey questionnaire was made up of 18 questions. Table 3.1 below shows how questions posed tie back to the literature in GP. The questionnaire provided a number of alternative answers from which respondents selected the option that most represented their views (Saunders et al., 2016; Solanke, 2015).

The first four unnumbered questions entailed giving informed consent to participate in this research. The next section, question 1 – 3, of the questionnaire aimed to obtain basic demographic information of the respondents. The demographic information was important for the study in order to determine respondents' levels of design experience in the built environment under a professional council.

Question 4 was closed ended. Questions 5 to 18 comprised sets of alternative answers from which respondents chose (closed-ended) and also gave respondents the option to answer in their own words (open ended). The closed-ended questions were therefore not limiting in any way. The questionnaire was designed to answer the

research objectives and was developed only after the literature had been read and carefully considered.

The second part dealt with the green procurement questions that were deemed relevant in order to answer the study's research objectives.

Table 3.1 How questions posed tie back to the literature in GP

Question no	Question	Literature source
1	Which professional council do you belong?	This question aimed to obtain basic demographic information of the respondents so as to know their applicable professional council, therefore does not tie back to the literature in GP.
2	How would you describe your age?	This question aimed to obtain basic demographic information of the respondents so as to know their age, therefore not tying back to the literature in GP.
3	How would you describe your years of design experience in the Built Environment?	This question aimed to obtain basic demographic information of the respondent's design experience, therefore does not tie back to the literature in GP.
4	Which National Department of Public works Office, where you implemented a green procurement project?	This question aimed to obtain basic demographic information of the respondents, therefore not tying back to the literature in GP
5	In your opinion, what is the focus for green procurement in National Department of Public works projects?	Amendments made to the building regulations in 2011 through South African National Standards (SANS 10400 – XA, 2011). Part X of SANS focuses on environmental sustainability while part XA focuses on energy use in buildings
6	How would you describe a period when you designed a project incorporating green procurement in National Department of Public works?	Balasubramanian and Shukla (2017) pointed out that limited studies have been conducted on the integration of environmental issues into the design stage of public sector projects.

7	Who has the most ability to enforce implementation of green procurement in National Department of Public works project?	Niemann et al., (2016) and Balasubramanian and Shukla (2017) concur that the purchaser's need for green services and products is one of the most vital driving forces of green approaches.
8	How is a decision made to implement green procurement in National Department of Public works projects?	Environment Canada has established EcoNexus™, an electronic database for sustainable products in support of workers, so as to promote environmentally responsible procuring decisions.
9	Are there legislation compelling designers to incorporate green procurement in the design of projects in National Department of Public works?	Moronge and Zawadi (2018) assert that government legislation is the driver that influences the application of green supply chain management.
10	Are there regulation compelling designers to incorporate green procurement in the design of projects in National Department of Public works?	Niemann et al., (2016) state that regulations are the key drivers influencing the execution of environmentally friendly supply chain in India's manufacturing industries.
11	Is there a policy in the National Department of Public works compelling designers to incorporate green procurement in the design projects?	The rise of GGP in developed countries is affirmed in a study by Geng and Doberstein (2007) who include Sweden in the list of countries which now uphold a policy that at least 40% of all government purchases are green.
12	Which of the following barriers are mostly associated with practising green procurement on National Department of Public works projects?	Muraguri et al., (2015) found that resistance to change was one of the greatest barriers to the introduction of green procurement in Kenya.

13	When last did your company tender or quote for a green procurement projects in National Department of Public works?	Ofori (n.d) states that the Commission of the European Union (2004) urged member countries to, amongst other actions, initiate sustainability practices in governments' bidding processes.
14	When last was your company appointed in a green procurement projects by National Department of Public works?	Testa et al., (2014) state that green procurement tender notices could include compulsory ecological aspects, such as technical specifications or other awarding requirements.
15	How many green procurement projects are you currently involved in National Department of Public works?	Chari and Chiriseri (2014) highlight that sound sustainable procurement practices are not carried out in Zimbabwe and that cost is still the main criterion for awarding tenders
16	How many completed (practical or final) green procurement projects you were involved in National Department of Public works in the last 5 years?	Public authorities across Europe have been practising green procurement for a number of years, and a recent study suggests that roughly half include green public procurement criteria in their tenders regularly (Muraguri et al., 2015).
17	Do tenders or quotations advertisement include green procurement criteria when sourcing consultants in National Department of Public Works?	The integration of green practices in the bid and contract conditions would guarantee adherence and would be beneficial to the environment (Bohari et al., 2017).
18	How would you characterize the practice of green procurement in the National Department of Public works?	Bohari et al., (2017) state that Singapore is a developed state and the status of green procurement practice in the country is advanced, to the extent that they carry out green fabrication as well as procuring.

3.4.1 Data collection

Numerous data collection techniques are available, such as the questionnaire, observation and the use of secondary data. Ruparathna and Hewage (2015) assert that the questionnaire is an inexpensive research method that enables the researcher to reach a wide range of respondents across a wide geographic area; hence it was adopted for this study. Questionnaire was used in this study as a data collection tool. The questionnaire was sent electronically through the Qualtrics software tool, accompanied by an introductory letter in which the objectives of the study and the rights of participants were explained.

The Qualtrics software questionnaire was accessed by respondents through a uniform resource locator (URL) link. The introductory part of the questionnaire gave the researcher's contact details in order to ensure that no one opted out because of an inability to clarify issues or ask questions. This step is recommended by Ruparathna and Hewage (2015) and was also done by Kiggundu (2014). Most respondents were also contacted by telephone to remind them of the survey, and some were called again just before the cutoff date for return of the questionnaires, which was 14 days from the time of sending. Reminder emails were also sent through Qualtrics to urge respondents to complete the questionnaire within the stipulated 14 days, as the link was designed to expire after that period.

It was advantageous that the calls were made, as many respondents said that they had not received the survey despite it having been sent to the correct email address. Some respondents were unreachable telephonically and did not respond to the emailed questionnaire.

Data was to be collected from external consultant architects and engineers executing design works on behalf of the National Department of Public Works, South Africa. Data was collected from 02 May 2018 and the two-week period was eventually extended to early June of that year. The Qualtrics research tool was utilised for the collection of data. The researcher conducted a pilot survey by sending the questionnaire to a few selected individuals, including colleagues who are engineers and architects, so as to examine the appropriateness of the questionnaire and allow opportunity to make improvements based on the remarks.

3.4.2 Data analysis

Data analysis is the sixth and last layer of Saunders's research onion. Data analysis involves an analysis of data collected so that a researcher may answer the research question or arrive at a conclusion. In data collection and analysis, the researcher's opinion is irrelevant; only the opinions and experiences of respondents are considered.

Several methods are used in data analysis, corresponding with study's research design (methodological choice) for collection of data (Saunders et al., 2016). Agyepong (2014), for instance used the mixed method (combination of qualitative & quantitative) approach for data analysis. This study adopted a mono method quantitative approach for data collection using a questionnaire, therefore it employs mono method quantitative procedure for data analysis. Molina Azorín and Cameron (2010) state that a mono method study uses only one type of method; one quantitative or one qualitative.

Again, Qualtrics software aided the researcher in the process of analysing data, enhancing clarity by recording and grouping responses according to themes. Data that was deemed irrelevant to the research objectives was discarded. The Qualtrics software offers various options such as CSV (comma separated values), PowerPoint slides, Excel and Word document for customising output. This study adopted for all four of these options, as may be seen in the appendices. Reports were therefore extracted in the form of PowerPoint slides and a Word document, after the data had been analysed by the software. The report generated by Excel allowed the researcher to view and analyse answers provided by the respondents to the open-ended questions.

For the Likert scale question (Q18), all responses were grouped together according to the level of agreement or disagreement described as follows, 1 = never use, 2 = almost never, 3 = occasionally or sometimes, 4 = almost every time and 5 = frequently use. The responses were therefore ranked based on the highest score using Microsoft Excel.

A detailed analysis of the data is presented in Chapter 4.

3.5 Population for this research

The target population for this study comprised of various built environment designers, who were either owners of consulting firms or employed by consulting firms to render professional services to state departments. In more detail, the population includes designers such as architects, civil, structural, electrical and mechanical engineers' who are external private consultants and not employees of NDPW. To ensure a single population, designers who are employees of NDPW or its implementing agents does not form part of this study. The respondents were a sample of the population differing in terms of years of design experience and registration with their built environment councils, namely, ECSA and SACAP. The sample represents the population targeted in the research question and objectives.

The names and contact numbers of respondents were sought from departmental project managers and heads of projects based at the regional offices of the National Department of Public Works (Johannesburg, Nelspruit, Polokwane) and the head office in Pretoria.

3.6 Sampling plan

Sampling is defined by Blumberg, Cooper and Schindler (2011) as the process of selecting some elements from a population to represent the population as a whole. Sekaran and Bougie (2016) concurs that the process of selecting the right individuals, objects, or events as representatives for the entire population is known as sampling. Probability sampling and non-probability sampling are commonly used sampling plans. With probability sampling, the probability or chance of each case being chosen from the targeted populace is known and is never zero (Saunders, et al., 2016). With non-probability sampling, the probability of each case being chosen is unknown (ibid).

The authors state that all probability sampling techniques require some form of sampling frame, so they are often more time consuming than non-probability techniques. Therefore, this study adopted the use of non-probability sampling as it was not possible to construct a sampling frame due to insufficient time and the study embraces cross-sectional time horizon. Snowball non-probability sampling was

employed where responses were not forthcoming. The professionals who did respond were asked to recommend colleagues who were involved in the design stage of projects run by the National Department of Public Works within the last five years. This approach is known as snowball sampling; a non-probability sampling method whereby participants in the research are found through referral by initial respondents (Saunders et al., 2016). The snowball sampling approach, as adapted from Wong et al., (2016) was suited to this study, and augmented the sample size. The approach was adopted because green procurement in South Africa is still new (Agyepong & Nhamo, 2015) and therefore respondents in the public sector with relevant knowledge are fairly hard to find. Balasubramanian and Shukla (2017) affirm that limited studies have been conducted in green design practices which examine the integration of environmental issues into the design stage. Representativeness and a minimum sample size are not considered imperative in non-probability sampling, unlike in probability sampling (Du Plooy-Cilliers, 2014).

The sample was selected from the Department's list of active and completed projects in the last five years (2013 to 2017) using the Project Management System (PMS). Construction projects within the five-year period is deemed current to provide the required sample of designers.

3.7 Validity and reliability

Validity and reliability are central to judgements about the quality of research in the natural sciences and quantitative research in the social science (Saunders et al., 2016). A pilot study was conducted to test the data collection instruments to sampled designers; consistent with a study by (Issaka, 2018).

Validity

is about determining if the measure is measuring the right thing (Hyman & Sierra 2015). Saunders et al., (2016) affirm that validity is (a) the degree to which the method of collecting data precisely measures what it was intended to measure and (b) the degree to which the survey results reflect what they claim to reflect. Hyman and Sierra (2015) state that there are several different types of validity as well as several ways to

assess it. Saunders et al., (2016) affirms the presence of various types of validity in research as illustrated below.

Content or Face Validity merely assesses whether your questionnaire items adequately represent the underlying construct of interest. Typically, content or face validity is assessed by asking subject-matter experts if the items 'make sense'. Saunders et al., (2016) affirm that, content validity refers to the extent to which the measurement device or questions in the questionnaire, provides adequate coverage of the investigative questions. The authors state further that, determining adequate coverage can be made in various forms; Careful definition of the research through literature reviewed or prior discussion with others where appropriate. Alternatively use a panel of individuals to assess whether each question in the questionnaire is "essential",

Predictive Validity also referred to as criterion validity, relates to whether a measure is predictive of something else you wish to predict. Saunders et al., (2016) affirm that criterion validity is another name for Predictive Validity. Hyman and Sierra (2015) note that it does not matter whether the measure 'makes sense' from a theoretical standpoint; if a measure is predictive, then it has predictive validity, although theoretically related measures tend to be more predictive. To the degree one measure predicts another one, you have achieved criterion or predictive validity. Saunders et al., (2016) note that criterion validity is concerned with the ability of the measures (questions) to make accurate predictions.

Convergent Validity: If you have a strong sense you are measuring the correct thing, then you should be able to develop alternative measures and the scores on those measures should be consistent (Hyman & Sierra, 2015). Saunders et al., (2016) affirm that where different scales are used to measure the same construct, the overlap (or correlation) between these scales is known as convergent validity.

Discriminant Validity is about ensuring that different scales measure different things; in essence, you have not confused measuring one thing with measuring another thing. To the extent you can guarantee your scale is measuring one thing and not another thing, you have achieved discriminant validity (Hyman & Sierra, 2015). Saunders et al., (2016) says that where different scales are used to measure theoretically distinct

construct, an absence of overlap (or correlation) between the scales means they are distinctive and have discriminant validity.

Nomological validity, defined as the degree to which predictions in a formal theoretical network are confirmed. Nomological validity is confirmed when all of the relations that comprise the network are supported in a single, omnibus test of model (Hagger, Gucciardi & Chatzisarantis, 2017)

In determining the appropriate validity, the abovementioned methods were evaluated and the study adopted content or face validity. The study's questionnaire was subjected to an assessment by ethics committee to assess whether each question in the questionnaire is "essential". The researcher conducted a pilot survey by sending the questionnaire to a few selected individuals, including colleagues who are engineers and architects, so as to examine the appropriateness of the questionnaire and allow opportunity to make improvements based on the remarks.

Reliability

Hyman and Sierra (2015) says that reliability in a research context is the degree to which measures are free from random error and, therefore, yield consistent results. Saunders et al., (2016) avow that reliability refers to replication and consistency.

Three common approaches to assessing reliability comprises of test re-test, internal consistency, and alternative form (Saunders et al., 2016).

Test re-test estimates of reliability are obtained by correlating data collected with those from the same questionnaire collected under as near equivalent conditions as possible. In this method, questionnaire needs to be delivered and completed twice by the respondents.

Internal consistency involves correlating the responses to questions in the questionnaire with each other. Cronbach's alpha is the frequently used method for calculating internal consistency.

Alternative form is the final approach to testing for reliability. It offers some sense of the reliability within the questionnaire through comparing responses to alternative forms of the same question or groups of questions. Alternative form method was

adopted by the study to test reliability by comparing the responses to alternative form of the same question or group of questions.

3.8 Storage of data

Data collected through the Qualtrics software tool was stored in a password-secured computer and located at the researcher's residence. The University of the Witwatersrand community will have access to the final research results and the report will ultimately be stored at the Wits Main Library

3.9 Ethical considerations

Wits University's highest ethical standards were followed since the integrity of research is the foundation for a top-quality study. An application for ethical clearance was approved in December 2017, permitting data collection. Further permission to conduct research was sought from the National Department of Public Works before data collection commenced.

The study was conducted within the bounds of prescribed ethical principles, consisting of confidentiality and non-bias, avoidance of harm to respondents and seeking of informed consent before the survey was conducted. Anonymity was maintained in that none of the participants' names were mentioned or used in the research. The researcher was aware of the danger of bias and vigilantly avoided the intrusion of personal bias into data analysis. Data was analysed honestly and objectively.

Nobody was coerced or forced to participate in this study. No harm was caused to the respondents, who were treated with respect during email or telephonic exchanges. All respondents were informed of their right to opt out of the study at any stage should they so desire.

3.9.1 Informed consent

The first four questions on questionnaire were unnumbered and sought basic information and informed consent from participants to participate in the survey, as suggested in Kiggundu (2014). The software was designed in such a way that should a participant opt not to give their consent, the survey automatically ended. These first four questions required participants to select either 'Yes' or 'No' regarding permission to partake in the survey. Partakers were enlightened that they would not receive any direct benefits from participating in the study, and that conversely there were no disadvantages or penalties for not participating. It was also made clear that participants could withdraw at any time or choose to omit any question they did not wish to answer. They were assured that the research would be completely confidential and anonymous, as names were not required, and the information given would be held securely and not disclosed to anyone else.

Informed consent was obtained from the respondents prior answering the survey.

3.10 Conclusions

This chapter has outlined the research methodology applied in this study. The study adopted a deductive (top down) approach as it is associated with quantitative research where a literature review preceded data collection (Saunders et al., 2016).

It begun with a recap of study's research problem and question, then illustrated the research philosophy, approach to theory development, methodological choice, research strategies, time horizon, Questionnaire design, data collection and analysis. It concluded by outlining the ethical considerations of the research.

The following chapter presents and analyses the data gathered.

CHAPTER FOUR: CONSTRAINTS ON DATA COLLECTION, DATA PRESENTATION, ANALYSIS AND RESULTS

4.1 Introduction

This chapter summarizes the constraints on data collection, presents the data gathered from the study and analyse the key findings in relation to the research objectives. The research objectives, as defined in Chapter 1, were to (a) identify policies, legislation and regulations enabling the practice of green procurement at the design stage of projects in the public sector, (b) find out the extent to which designers practise green procurement at the design stage of projects in the public sector. and (c) Investigate the major barriers, if any, associated with practising green procurement by architects and other designers at the design stage of projects in the public sector.

It was envisaged that the achievement of these three research objectives would enable the student to tackle the research question, identified in Chapter 1 as: 'To what extent is green procurement practised by designers, in particular engineers and architects, at the design stage of construction projects within the public sector?.'

The survey's results were employed to meet the research objectives using the methods described in Chapter 3. Qualtrics software was utilised to collect data, as described in Chapter 3. The survey itself was preceded by questions dealing with ethical and demographical matters. Data was exported to Microsoft power point and excel so as to compute the analysis.

4.1.1 Constraints on data collection

The study encountered some constraints during its execution:

(1) I suffered the loss of my wife, as highlighted in the Dedication of this study, and for four to five months was unable to proceed due to lack of strength. I had planned to complete the literature review by the end of June 2018, but in the end completed it only on 10 December 2018. Data collection was scheduled for completion by the end of May 2018 but in the end concluded during June 2018.

(2) NDPW's green procurement policies, legislation and regulation documents are excluded from this study since were not received from the department. There were prolonged delays in response to request for the cited documents, and in the end, nothing was provided.

(3) The study did not address green procurement practice at the design stage of projects executed by provincial Departments of Public Works and its implementing agents.

(4) Some of the questions in the questionnaire were not asked in a manner to focus on the design stage.

4.2 Ethical considerations

The questionnaire was preceded by four preliminary questions addressing ethical aspects. All participants agreed to participate. All except one agreed that participation should remain anonymous, and gave permission for anonymous quotes to be used in the final report. Permission was also granted for other researchers to use the findings.

4.3 Demographic information

According to literature, the purpose for this demographic question was to understand the characteristics of every participant taking the survey and it is essential when determining whether individuals in a particular study are a representative sample of the target population for generalization sake. Saunders et al., (2016) define demographic variable as a variable that records data about characteristics. The following three questions (1 through 3) related to demographical information and gave the researcher some familiarity with those taking part in the survey.

4.3.1 Participants' response rates

Response rate is the total number of responses divided by the total number in the sample exclusive of ineligible respondents. (Saunders et al., 2016). The total number

of responses for this study is 35 including 6 partial completed responses. Complete responses were considered for analysis amounting to 64% wherein partial responses, mostly engineers were discarded. Partial responses is the level of response to questionnaire or interviews in which 50% to 80% of all questions are answered other than by a refusal or no answer (Saunders et al., 2016). Therefore 6 responses being partial complete were discarded from data analysis.

This study consisted of a sample size of 45 designers – broken down into 15 Architects, 10 Civil engineers, 5 Structural engineer, 10 Electrical engineer and 5 Mechanical engineers. Zhao, Hwang and Low (2014), state that the central limit theorem is valid with a sample size of 30 or over. Ruparathna and Hewage (2015) concurs that the central limit theorem in statistics designates that a sample size ought to be a minimum of 30. Therefore, the sample size of 45 in this study is acceptable.

Question 1 asked which professional body participants were registered with; most were registered with the Engineering Council of South Africa (ECSA) and the South African Council for the Architectural Profession (SACAP). The majority of responses received were from Architects by 33 %. Civil engineers' responses amount to 16% as the second highest followed by Mechanical engineers at 9% and lastly Electrical engineers were at 7%.

An adjustment of response rate was necessary due to an incorrect or change of respondent's contact details and emails landing on junk mail box necessitated sending of the survey more than twice to single participants. Therefore, only survey sent once and successfully completed was considered for data analysis. Table 4.1 shows participants' response rates.

Table 4. 1: Participants’ response rates

Designers	Sample size	Number of responses	Number of incomplete responses	Number of completed responses for data analysis	% of Response rate
Architects	15	15	0	15	33
Civil engineers	10	7	0	7	16
Structural engineer	5	0	0	0	0
Electrical engineer	10	6	3	3	7
Mechanical engineer	5	7	3	4	9
Total	45	35	6	29	64

4.3.2 Ages of participants

Question 2 aimed to find out participants’ ages as portrayed by Table 4.2. In total 41% of those sampled responded to this question while 59% chose not to respond. The majority of participants who (33.33%) were aged between 51 and 60 years, followed by 31 to 40 years (25%) and lastly 16.67% each for ages, 41 to 50 and 61 years and above.

Table 4.2: Participants’ ages

#	Answer	%	Count
1	20 to 30	8.33%	1
2	31 to 40	25.00%	3
3	41 to 50	16.67%	2
4	51 to 60	33.33%	4
5	61 and above	16.67%	2
	Total	100%	12

4.3.3 Participants’ years of design experience

Question 3 sought to find out respondents’ years of design experience, as shown on Table 4.3. In total 100% answered the question as follows: 13 respondents (44.83%) stated that they had 21 years or above of design experience followed by 17.24% of 11

to 15 years. There was an equal percentage (13.79%%) of those who had 6 to 10 years and those who had 16 to 20 years of design experience. Lastly, 3 responses (10.34%%) was recorded for designers with 1 to 5 of design experience.

Table 4.3: Participants' years of design experience

#	Answer	%	Count
1	1 to 5 years	10.34%	3
2	6 to 10 years	13.79%	4
3	11 to 15 years	17.24%	5
4	16 to 20 years	13.79%	4
5	21 and above years	44.83%	13
	Total	100%	29

4.4 Data analysis

The method used for data analysis is narrated on 3.4.2 (chapter 3) and data was presented according to research objectives. The first objective of this study was to find out whether the National Department of Public Works had legislation, policies or regulations in place to govern green procurement. Legislation, policies and regulations are identified by the literature as key drivers of green procurement and their existence ought to stimulate designers to incorporate green procurement practices when designing projects. Responses to this question would therefore aid in answering the research question.

4.4.1 Legislation

Question 9, 10 and 11 dealt with legislation, policies and regulations governing green procurement.

Question 9 investigated the matter of legislation within the National Department of Public works. In total, 29 responses (100%) were received. The majority (62.07%) reflected that legislation does exist.

In total, 20.69% of respondents stated that there was no legislation, and the remaining 17.24% were not sure. Table 4.4 depicts responses with regard to the existence of legislation.

Table 4.4: Existence of legislation in the department

#	Answer	%	Count
1	Yes	62.07%	18
2	No	20.69%	6
3	Not sure	17.24%	5
4	Other	0.00%	0
	Total	100%	29

4.4.2 Regulations

Question 10 sought to explore the presence of regulations. Table 4.5 shows responses to the question of regulations in the Department. A total of 29 participants (100%) responded. Most respondents (68.97%) reported that regulations were available. In contrast, 17.24% stated that regulations did not exist, and 13.79% were unsure. However, the two latter responses are not in the majority.

Table 4.5: Presence of regulations in the Department

#	Answer	%	Count
1	Yes	68.97%	20
2	No	17.24%	5
3	Not sure	13.79%	4
4	Other	0.00%	0
	Total	100%	29

4.4.3 Policy

Question 11 sought to uncover the existence of a policy in the National Department of Public Works that compelled designers to incorporate green procurement practices at the design stage of projects. Table 4.6 reflect responses on the existence of policies in the Department. In total 29 responses were received (100%). The majority of respondents (48.28%) indicated that a policy exists compelling designers to incorporate green procurement standards in the design phase of projects in the Department, while 17.24% stated the opposite. The second highest score was 34.48% for those who were unsure whether a green procurement policy existed in the Department or not.

Table 4.6: Existence of policy in the Department

#	Answer	%	Count
1	Yes	48.28%	14
2	No	17.24%	5
3	Not sure	34.48%	10
4	Other	0.00%	0
	Total	100%	29

4.5 Barriers associated with practising green procurement

The second objective was to investigate major barriers associated with practicing green procurement by architects and other designers during the design phase of construction projects in the National Department of Public Works. Table 4.7 presents the responses to Question 12.

In total 29 participants responded (100%). In total, 37.93% viewed lack of client commitment to or readiness for green procurement as the number one barrier in the Department, followed by 20.69% who stated that the client's lack of knowledge on green procurement was the major barrier. These two barriers are of course closely associated with one another. Minor barriers reported include the designer's lack of knowledge (10.34%), lack of incentives provided by government for green procurement (6.90%), absence of regulations for green procurement (3.45%), lack of policy and guidelines on green procurement (3.45%), and lack of green materials in the market (3.45%). In total, 10.34% were not sure which barrier applied, while another 3.45% opted for 'other' without providing any input.

Table 4.7: Barriers to green procurement in the Department

#	Answer	%	Count
1	Designer's lack of knowledge in green procurement	10.34%	3
2	Lack of Client commitment or readiness in green procurement	37.93%	11
3	Client's lack of knowledge in green procurement in green procurement	20.69%	6
4	Lack of legislation in green procurement	0.00%	0
5	Lack of regulations in green procurement	3.45%	1
6	Lack of policy and guidelines in green procurement	3.45%	1
7	Inadequate role played by Built Environment professional councils or Bodies in green procurement	0.00%	0
8	Lack of green materials in the market	3.45%	1
9	Lack of incentives provided by Government in green procurement	6.90%	2
10	Lack of Municipal policy, guidelines etc in green procurement	0.00%	0
11	Not sure	10.34%	3
12	Other	3.45%	1
	Total	100%	29

4.6 The extent to which designers practise green procurement

The third and last objective involved finding out the extent to which designers practise green procurement. Several questions were asked, as detailed below, in an effort to address this objective.

Question 4 sought to identify the Department of Public Works regional or office in which the designer had implemented a green procurement project. Positive feedback for this question would confirm the designer's involvement in a green procurement project in the Department. A total of 29 designers answered this question (100%). Polokwane Regional Office had the highest number of respondents who had implemented a green procurement project (62.07%%) followed by the Nelspruit Regional Office at 20.69%. In total, 3.45% of the respondents had implemented green

projects for Head Office, and the same percentage had done so for the Johannesburg regional office. About 10.34% of the respondents reported that they had not implemented a green procurement project for any of the offices. Table 4.8 shows the offices where green procurement projects had been executed by the designers.

Table 4.8: Offices where green procurement projects were executed

#	Answer	%	Count
1	Bloemfontein Regional Office	0.00%	0
2	Cape Town Regional Office	0.00%	0
3	Durban Regional Office	0.00%	0
4	Head Office, Pretoria	3.45%	1
5	Johannesburg Regional office	3.45%	1
6	Mmabatho Regional Office	0%	0
7	Nelspruit Regional Office	20.69%	6
8	Kimberley Regional Office	0.00%	0
9	Polokwane Regional Office	62.07%	18
10	Port Elizabeth Regional Office	0.00%	0
11	Pretoria Regional Office	0.00%	0
12	Mthatha Regional Office	0.00%	0
13	None	10.34%	3
	Total	100%	29

4.6.1 Green procurement focus

Question 5 inquired about the green procurement focus in the National Department of Public Works' construction projects. This question desired to determine the nature of the green procurement practiced by the Department. On this one, 29 respondents (100%) participated in this question. The majority (82.76%) stated 'energy saving' as the main focus for green procurement projects. In total 10.34% were not sure of the Department's green procurement focus in its projects. Resources saving and environmental protection were each selected by one participant (3.45%) as the focus for green procurement. Table 4.9 shows responses for green procurement focus.

Table 4.9: Green procurement focus

#	Answer	%	Count
1	Energy saving	82.76%	24
2	Resources saving	3.45%	1
3	Environmental protection	3.45%	1
4	Climate change intervention	0.00%	0
5	Not sure	10.34%	3
6	Other	0.00%	0
	Total	100%	29

4.6.2 Stakeholder with the greatest ability to enforce GP implementation

Question 7 investigated which stakeholder had the greatest ability to enforce green procurement in the National Department of Public Works' construction projects. The question sought to find out who the influential stakeholders were when it comes to green procurement. A total of 29 responded (100%). Thirteen respondents (44.83%) stated that the client had the greatest ability to enforce green procurement in the Department's construction projects. A further 31.03% said that the designer had the most ability and 24.14% said that 'all stakeholders' had the greatest ability to enforce green procurement in the National Department of Public Works' projects. Table 4.10 shows responses for the stakeholder with the greatest ability to enforce green procurement.

Table 4.10: Stakeholder with the greatest ability to enforce GP

#	Answer	%	Count
1	Client	44.83%	13
2	Designer	31.03%	9
3	Municipality	0.00%	0
4	All stakeholders	24.14%	7
5	Not sure	0.00%	0
6	other	0.00%	0
	Total	100%	29

4.6.3 Green procurement criteria for advertised tenders or quotations

Question 17 investigated whether the Department's tenders or quotation advertisement included green procurement criteria for the sourcing of consultants. Feedback to this question intended to ascertain the extent to which designers in the Department were aware of GP considerations at the tender or quotation stage.

In total 29 responses (100%) were received. The majority, 55.17%, reported that the Department's tenders or quotation advertisements did not include green procurement criteria for the sourcing of consultants, while 24.14% stated that they were not sure. Only 20.69% indicated that the Department's tenders or quotations advertisements included green procurement criteria for the sourcing of consultants. Table 4.11 depicts the responses for this question.

Table 4.11: GP criteria for advertised tenders or quotations.

#	Answer	%	Count
1	Yes	20.69%	6
2	No	55.17%	16
3	Not sure	24.14%	7
4	Other	0.00%	0
	Total	100%	29

4.6.4 The status of green procurement practice

Question 18 sought to uncover the status of green procurement in the National Department of Public Works. A five-point Likert scale ranging from 1 = Never use to 5 = Frequently use, was used to assess the current status of green procurement practice in the Department according to the respondents: 1 = Never use, 2 = Almost never, 3 = Occasionally or Sometimes, 4 = Almost every time and 5 = Frequently use. For this question, data was exported to Microsoft excel for ease of analysis. The Mean score was derived by adding the total scores per Likert scale option and divided by the number of respondents.

The majority of respondents, 41.38% said that green procurement was practised 'occasionally or sometimes' (score 3). The second highest score of 13.79% responded with option 1, 'never use'. There was a tie in respect of responses for option 2 (Almost

never) and 5 (Frequently use), by 10.34%. Lastly, 6.90% of participants avowed that the status of green procurement practice was at level 4, 'almost every time'. Table 4.12 shows the Likert scale responses for this question.

Table 4.12: The state of green procurement practice.

Number of respondents	1 = Never use, 2 = Almost never, 3 = Occasionally or Sometimes, 4 = Almost every time and 5 = Frequently use				
5					5
6			3		
7	1				
8			3		
11			3		
12				4	
13			3		
14			3		
15			3		
17			3		
18		2			
19			3		
20		2			
22			3		
26				4	
27			3		
29					5
30		2			

31	1				
32	1				
34			3		
35			3		
36	1				
37					5
Mean score	1	2	3	4	5

4.7 Chapter summary

This chapter has communicated the results as yielded by the survey questionnaire and analysed them in relation to the study's objectives.

The first objective was to find out whether legislation, policy or regulations guided the designers in their incorporation of GP during the design stage of projects in the Department. The findings suggest that legislation, regulations and policies do exist but are not universally known.

With regard to the second objective, questions 4, 5, 7, 17 and 18 were asked. This objective purposed to find out the extent to which designers practised green procurement at the design stage of construction projects. The regional offices of Polokwane and Nelspruit had the largest share of projects incorporating green procurement, with the focus being energy saving. The client was found to have the greatest ability to enforce green procurement at the design stage in the Department's construction projects. However, according to the respondents, the Department's tenders and quotation advertisement for sourcing of consultants do not generally include green procurement criteria. This is in contrast to what is recommended in the literature; green procurement is not a priority at the tender stage for the sourcing of consultants, whereas the literature stresses that for it to be practised at all it needs to be included at all stages. Furthermore, question 18 (Likert scale) affirm that green procurement was practised 'occasionally or sometimes' (3).

The third and last objective was to investigate major barriers, if any, associated with the practice of green procurement by architects and other designers at the design stage of projects in the Department. The respondents viewed lack of client commitment or readiness followed by client's lack of knowledge as the major barriers.

In conclusion, the findings affirm that the current status of green procurement practice is not high at the Department of Public Works. The designers stated in question 17 that the Department's tenders or quotation advertisements did not include green procurement criteria for the sourcing of consultants. Most designers concede in question 18 (Likert scale) that green procurement was practised 'occasionally or sometimes' (3).

The results indicate that the study's research objectives were met based on the aforesaid objectives. These results are the opinion of the respondents and not those of the researcher.

This chapter has presented and analysed the study's results. The following chapter discusses the findings in relation to the literature.

CHAPTER FIVE: FINDINGS AND DISCUSSION

5.1 Introduction

This chapter discusses the findings and then compares them with findings from the literature. The findings are presented according to the study's research objectives. For the purpose of this chapter, the objectives are recapped, as follows: the first objective was to identify policies, legislation and regulations enabling the practice of green procurement at the design stage of projects in the public sector. The second objective wished-for finding out the extent to which the designers practise green procurement at the design stage of projects in the public sector. The third objective was to investigate major barriers, if any, associated with the practice of green procurement by architects and other designers at the design stage of projects in the Department of Public Works, South Africa.

5.2 Discussion of the findings

5.2.1 Objective 1: Ascertain the existence of legislation, regulations and policy

The study's **outcomes make it clear that legislation does** exist compelling designers to incorporate green procurement principles into the design stage of departmental construction projects. The existence of legislation ought to compel all designers to design projects in compliance with green procurement principles or practices, with failure to do so resulting in consequences such as penalties. The fact the 20.69% stated that there is no legislation is cause for concern, compounded by the fact that 17.24% were unsure about it. However, the two latter responses are not in the majority. The findings, therefore, support the literature which states that governments can use the top-down approach to urge stakeholders to adopt green practices. The review of literature revealed that legislation, regulations and policies are the drivers of green procurement in developed countries. Ahsan and Rahman (2017) aver that the UK government plays a dominant role in persuading GPP application through legislation. Moronge and Zawadi (2018) assert that government

legislation is the driver that influences the application of green supply chain management.

The next finding is that regulations are in place compelling designers to incorporate green procurement as they design projects. The existence of regulations upholds previous studies that found that the State is the enabler for sustainable approaches. Government laws or regulations force companies to adopt green supply chain management in the developed countries. The findings of this study uphold the findings of Testa et al., (2014) who state that the incorporation of ecological concerns into procuring policies is particularly supported through regulations. Niemann et al., (2016) state that regulations are the key drivers influencing the execution of environmentally friendly supply chain in India's manufacturing industries. Kahanaali et al., (2015) state that regulatory enforcement influenced China's auto industry to adopt green supply chain approaches, and was a significant stimulus.

Regarding the first objective, the majority of respondents in this study agreed that a **policy exists compelling designers to incorporate green procurement principles** during the design stage of projects in the Department. The figure of 17.24% who deny the existence of policy and 34.48% who are unsure is worrisome. Further research should be done to ascertain whether or not such a policy exists. Based on the responses to this question, one must conclude that a policy does exist, since the majority of respondents concurred with the statement. Muraguri et al., (2015) point out that the government of Kenya succeeded in setting up an extensive network of policies, including legislation, to regulate business activities in an effort to implement green procurement practice. Wong et al., (2016) aver that several years ago, Hong Kong announced numerous policy actions towards accomplishing green expansion together with lower-carbon lifestyles; one was a green procurement policy that mandated government departments to reflect eco-friendly matters when acquiring goods and services. However, Agyepong and Nhamo (2015) contend that green procurement is still fresh in developing countries and that no national policy exists in South Africa specifically to cover it. The findings in this study contrast with the findings in many other studies, in that no particular policy on green procurement exists in South Africa.

5.2.2 Objective 2: Determine the extent to which designers practise GP

The findings of question 4 show that the designers had undertaken green procurement projects in the regional office of Polokwane and Nelspruit. This result therefore suggests that some designers appointed as consultants or external service providers do practise green procurement at the design stage of public sector projects, albeit to widely varying degrees across the regional offices. Isa et al., (2018) assert that substantial variations capable of delivering highly valued paybacks for sustainability are best crafted during the conception or design phase.

The majority on question 5 signalled 'energy saving' as the main focus for green procurement projects in the Department, which confirms that actions are being taken to conserve electricity and indirectly, the environment. The finding in this regard concurs with much of the literature, and shows that the Department of Public Works undertakes green procurement interventions during the design stage or the retrofit of projects, focusing mainly on energy saving. According to the DPW's Revised Strategic Plan (2015-2020), fifty public buildings were retrofitted with energy efficiency technology between 2015 and 2020, and twelve were retrofitted with water efficiency technologies. As per the White Paper on Promotion of Renewable Energy and Clean Energy Development (2002), South Africa plans to move its energy portfolio away of coal dependence to sustainable energy sources (Nhamo & Mjimba, 2014). The signing of agreements in March 2018 between the government and 27 renewable energy independent power producers seems to confirm the suggestion that the focus of the government's green procurement is mostly energy conservation. This is further confirmed by amendment to the building regulations in 2011 through the South African National Standards (SANS 10400 – XA: 2011). Part X of SANS focuses on the environment while part XA focuses on energy use in building.

This study uncovered the current status enjoyed by green procurement practise in the National Department of Public works as attested by findings of question 18. Most respondents viewed green procurement to be implemented 'occasionally or sometimes' at the design stage of construction projects. The fact that tender or bid advertisements omit GP criteria explains why GP is only 'occasionally or sometimes' practised.

5.2.2.1 Stakeholders with the greatest ability to enforce GP implementation

Most participants confirmed that the client has the greatest ability to enforce green procurement implementation, and is therefore the strongest driver or hindrance to green procurement. This finding concurs with the literature. The client is invariably the first stakeholder to influence designers to adopt the 'green' concept, especially where green policies or legislation are not in effect.

According to the literature, clients request green design elements with a view to selling or leasing, since such elements enhance a building's value. The findings, therefore, confirm those of Kiggundu (2014), who asserts that clients have the highest impact on projects in terms of scope, responsibility for setting up the project team, project specifications and the procurement method to be followed. Designers design projects based on client specifications or needs. Niemann et al., (2016) and Balasubramanian and Shukla (2017) concur that the purchaser's need for green services and products is one of the most vital driving forces of green approaches.

5.2.2.2 GP criteria for advertised tenders or quotations

The results of this survey indicate that the National Department of Public Works does not include green criteria in its tender notices or requests for quotations when sourcing consultants. A contradiction between the findings and the literature exists in this regard. Testa et al., (2014) refer to the possible environmental gains made when green principles are thoroughly integrated into government bids, mentioning a 25% decrease in CO₂ emissions as a result of GPP practices between 2006-2007 in seven European countries – Austria, Denmark, Finland, Germany, Great Britain, the Netherlands and Sweden. This applied for ten categorises of products analysed. The integration of green practices in the bid and contract conditions would guarantee adherence and would be beneficial to the environment (Bohari et al., 2017). Ofori (n.d) states that the Commission of the European Union (2004) urged member countries to, amongst other actions, initiate sustainability practices in governments' bidding processes.

5.2.3. Objective 3: Ascertain the barriers to green procurement

Most respondents considered the non-existence of client commitment or readiness with regard to green procurement to be the number one barrier in the Department. This barrier is associated with resistance to change. The literature recommends that organisations intending to implement green procurement invest more resources and attention into the aspect of resistance to change. Bohari et al., (2017) established that recent graduates who were exposed to sustainability at tertiary education level encounter industry resilience when attempting to translate their green ideas into practice. Wessels (n.d) states that in developing countries, attitude may be the most challenging aspect to overcome. People invariably cling to what they know, and the response to anyone seeking to implement change is frequently 'but we have always done it this way'. Muraguri et al., (2015) found that resistance to change was one of the greatest barriers to the introduction of green procurement in Kenya. On the whole, it may be concluded that lack of client commitment or readiness with regard to green procurement is a major barrier for the practice of green procurement within the Department. The findings differ from much of the literature, particularly the studies emanating from developing countries, where a lack of legislation and regulations were found to be the main barrier. In contrast, lack of regulations and policy were only the fifth barrier in the Department, according to respondents in this study.

The second most cited barrier was client's lack of knowledge on green procurement. Balasubramanian and Shukla (2017) state that internal barriers in the UAE, for instance, include lack of awareness and knowledge on green practices. The literature affirms that a lack of familiarity is a common obstacle to green procurement (Yu et al., 2018; Ahsan & Rahman, 2017). In this area, the findings concur with the literature from developing countries.

5.3 Chapter summary

According to the literature, legislation, regulations and policy were affirmed as key drivers of green procurement. This survey revealed that the practice of green procurement, where it exists, is client driven rather than driven by legislation, regulations and policy, as attested to by question 8.

Many respondents stated that the client has the greatest ability to enforce green procurement in the Department's building projects. The client's demand for green procurement puts pressure on designers to acquire the relevant skills so as to design in ways that are environmentally friendly. The client is therefore the most influential stakeholder in projects, since they hold the financial resources and the power. Testa et al., (2014) state that the usage of green standards in government purchasing can be a very good way of invigorating the fabrication of greener products. The client is therefore the main driver of green procurement implementation.

It was also found out that the Department of Public Works' green procurement mainly takes the form of energy saving measures. Again, the practice with respect to the Department's tenders or quotation advertisements is not to include green procurement criteria into the sourcing process of consultants. The sourcing process for consultants should include the stipulation that green design principles be incorporated in the projects, and all tenders and quotation advertisements should include a stipulation about green procurement principles, as recommended in the literature. Testa et al., (2014) state that green procurement tender notices could include compulsory ecological aspects, such as technical specifications or other awarding requirements. The integration of green practices in the bid and contract conditions could also ensure adherence, which would be beneficial to the environment (Bohari et al., 2017). The findings in this study are affirmed by the fact that the current status of green procurement practice is not high at the Department of Public Works. This may well be due to the fact that green procurement is seen as an afterthought or 'added bonus' and not made integral to the project at the tender notice stage. The topical poor status of implementation in South Africa is cause for concern and does not support Section 24 of the Constitution. The International Institute for Sustainable Development (IISD) (2008) states that Section 24 of South Africa's 1996 Constitution asserts everyone's right to live in surroundings which are not injurious to health and requires that

ecosystems are safeguarded for coming generations by means of rational law-making. The aim is to (a) avert ecological deterioration through the use of contaminants (b) promote environmental preservation and (c) ensure environmentally viable expansion and the sustainable mining of minerals while encouraging defensible socioeconomic development.

This chapter discussed the findings in relation to the research objectives and the literature. The following chapter concludes the study.

CHAPTER SIX: CONCLUSION

6.1 Introduction

This chapter draws conclusions and makes recommendations based on the findings. The study aimed to determine the level of green procurement practice by designers at the design stage of public sector construction projects, with a focus on the National Department of Public Works, South Africa. It was a quantitative study.

6.2 Overview of the research methodology

The study was exploratory in nature, since very few studies exist on GP practices at the design stage of construction projects. This exploratory study acknowledged the use of interpretivism philosophy; strives to build-up on the limited knowledge in green procurement at the design stage of projects in the public sector; with a purpose of creating new, richer understandings and interpretations of social worlds and contexts.

The study used a deductive approach most suited to quantitative research, in which the literature was reviewed before new empirical data was collected. The literature review assisted with the formulation of the research problem and research questions, as well as the drafting of a structured questionnaire. Three objectives were formulated; to investigate policies, legislation and regulations enabling the practice of green procurement at the design stage of projects in the public sector, to uncover the extent to which designers practise green procurement at the design stage of projects in the public sector and to investigate the major barriers, if any, to the practice of green procurement by architects and other designers at the design stage of projects in the public sector.

This study embraced a mono method quantitative approach for data collection using a questionnaire and corresponding quantitative analytical procedure known as mono method quantitative study. The enquiry decided on the use of survey strategy because it embraces a deductive research approach, applicable on exploratory studies and used on questionnaire for collection of standardised data in a cost-effective manner. This study conforms to cross-sectional time horizon, given that it was time bound due

to insufficient time available. In data collection, the researcher used a web-based Qualtrics software to develop the instrument; comprised of 18 questions. The survey was emailed to architects and to civil, structural, electrical and mechanical engineers through a URL link accessed via the internet. The results were recorded automatically by Qualtrics software as each question was answered.

A snowball non-probability sampling was used to reach out to potential participants after many failed to respond to the survey. Participants were asked to recommend colleagues who were or had been involved at the design stage of construction projects in the National Department of Public Works.

Analysis of data was automated by Qualtrics software subsequent to data collection. The software offered various formats for the analysis, such as CSV (comma separated values), PowerPoint slides, Excel and Word document. This study adopted all formats, as may be seen in the appendices. One report was extracted using PowerPoint slides and a Word document, once the results were analysed, and another report was extracted using Excel, allowing the researcher to view and analyse all the answers provided by the respondents to the open-ended questions.

6.3 A review of the limitations, and how they were addressed

Despite several limitations encountered herein, the results are relevant. The main limitation was that a request for a green procurement policy, legislation or regulation document was never received from National Department of Public Works' Policy, Research and Regulation unit. The request was sent via email and followed up with telephone calls, but initial contact came to nothing in the end. A search was then conducted on the Department's website for evidence of a green procurement policy, legislation or regulation, also to no avail.

However, the answers provided by the respondents are a true reflection of their ideas and opinions, and are untouched by the researcher's views. Chapter 4 provided the raw data extracted from Qualtrics software's PowerPoint slides. Other versions of the results can be accessed in the appendices.

Another limitation for the study is that snowball non-probability sampling was used to reach out to potential participants. Results were initially sought from most regional offices of the National Department of Public Works, but most failed to take the survey or failed to give feedback where contact was established. In the end, the study used information from the National Department of Public Works' Head Office in Pretoria, and the Johannesburg, Nelspruit and Polokwane regional offices.

In order to minimise the limitation of low numbers, the author contacted all participants telephonically, reminding them to complete the questionnaire already sent. The snowball non-probability sampling approach also helped to augment numbers and make up for some of the non-responses – as was done by Wong et al., (2016). Snowball sampling is a non-probability sampling method wherein participants are added to the numbers through referrals by initial respondents (Saunders et al., 2016). Ruparathna and Hewage (2015) argue that the central limit theorem in statistics stipulates that the sample size should be a minimum of 30. Zhao, Hwang and Low (2014) concur with this. Therefore, the sampling distribution of 45 participants is normal and acceptable.

6.4 Addressing the research aim and objectives

The study aimed to determine the levels of green procurement practice by designers at the design stage of public sector construction projects. Three objectives were devised, consistent with the stated aim.

The first was to identify policies, legislation and regulations enabling the practice of green procurement. The literature makes it clear that policy, regulations and legislation are the main instruments used by developed countries to drive green procurement in the public and private sectors. Many scholars have found that where these influential instruments are absent, green procurement lags. As per the literature, organisations ought to develop policies in favour of green procurement so as to enhance acceptance and implementation. The study found that some legislation, regulations and policies exist in the Department, with the majority of the respondents attesting to this. However, the finding was that the decision as to whether or not to implement green procurement

projects is made by the client, which ultimately is more influential than legislation, regulations and policies. Findings from question 9, 10 and 11 sought to uncover the nature of this enabler.

The second objective was to find out the extent to which designers practice green procurement. Several questions were asked in relation to this issue. The results for question 4 identified Polokwane and Nelspruit as the regional offices where the sampled designers undertook green procurement projects at the design stage in the Department of Public Works.

Question 5 inquired about the green procurement focus in the National Department of Public Works' construction projects. The literature identifies the building industry as the leading user of energy and one of the chief causes of environmental pollution, with energy expended throughout the lifecycle of a building, i.e., fabrication of construction materials, transportation, erection and operation of the completed building. The findings of question 5 confirmed that energy saving is the main focus at the design stage of projects in the Department's green procurement.

Question 7 investigated which stakeholder was most influential with regard to green procurement practices in the National Department of Public Works. The literature upholds the client (i.e., the public sector) as the key driver or barrier to GP. The client's stipulated requirements ought to stimulate acceptance and implementation of GP approaches. The finding for question 7 was that the client has the greatest ability to enforce green procurement at the design stage of projects when implementing Department's construction projects, and in this respect concurs to some extent with the literature.

Question 17 asked whether the Department's tenders or quotation advertisements included GP criteria in the sourcing of consultants. The literature recommends that green procurement practices be incorporated in all construction stages, including the tender or bid stage, to ensure that it remains a priority. The majority of respondents in this study stated that the Department's tenders or quotation advertisements did not include green procurement criteria. This is evident in the fact that green procurement does not enjoy a high status in the Department and is practised in piecemeal fashion.

Question 18 aimed to uncover the status enjoyed by green procurement in the National Department of Public works. Most respondents viewed the status of green procurement to be applied 'occasionally or sometimes'. The low status of green procurement is also attested to in the findings for question 17. The fact that tender or bid advertisements omit GP criteria explains why GP is only 'occasionally or sometimes' practised.

The last objective was to investigate the major barriers associated with practising green procurement by architects and other designers in the Department. The literature lists resistance to change as one of the key barriers to green procurement in both sectors. The respondents in this study viewed lack of client commitment or readiness with regard to green procurement as the number one barrier in the Department. This barrier is associated with resistance to change. The literature states that where resistance to change exists, motivation of employees, along with education and the raising of awareness, is warranted. Lack of knowledge with regard to green procurement is also affirmed by the literature as a major barrier. This barrier ranked second after resistance to change in this study. Organisations where knowledge is lacking ought to invest in training so as to resolve the barrier.

Interestingly, both barriers found by this study are associated with the client. These barriers ought not exist in a Department such as Public Works which, according to the majority of participants, has at least some legislation, regulations and policies in place.

6.5 Addressing the research questions

The research question was, 'To what extent is green procurement practised by designers, in particular engineers and architects, at the design stage of construction projects within the public sector'. Designers in majority conceded as per findings of question 18 (Likert scale) that green procurement was practised 'occasionally or sometimes' (3).

6.6 Addressing the research problem

The study's problem statement emanated from the fact that "There is limited application of green procurement by designers, in particular engineers and architects, at the design stage of construction projects within the public sector". Few studies have been undertaken to examine green procurement at the design stage of construction projects. The National Department of Public Works, South Africa, was used as a context for this study in an investigation into the concept of green procurement at the design stage of projects executed by external service providers such as consultant architects and engineers.

As a result of this completion of this study, this problem no longer exists – results have been obtained that fulfil the dearth of information on the topic. Feedback from question 4 makes it clear that, of the regional offices studied, the Department of Public Works' Polokwane and Nelspruit offices have implemented the green procurement at the design stage of construction projects. This is attested to in the finding from question 5 which confirms that the Department of Public Works sometimes undertakes green procurement interventions during the design stage or engages in the retrofit of projects, focusing mainly on energy savings. However, the findings reveal a limitation to the success of green procurement, in that tender and quotation advertisements fail to incorporate green procurement criteria for the sourcing of consultants.

In a key area, the findings do not correspond with the literature. According to the literature, legislation, regulations and policies are key drivers of green procurement. This study revealed that the decision of whether or not to implement green procurement is driven by the client rather than by legislation, regulations and policies – as is revealed by findings from question 8.

6.7 Overarching results from the study

The empirical findings imply that the majority of participants have participated in a green procurement project at the Polokwane regional office, followed by the Nelspruit regional office. The findings show that the Department of Public Works does undertake projects incorporating green procurement, albeit to widely varying degrees by the various offices. According to DPW's revised strategic plan (2015-2020), fifty public

buildings have been retrofitted with energy efficiency technology and twelve buildings were retrofitted with water efficiency technologies. However, the status of green procurement practice is still low, with projects implemented only 'occasionally or sometimes'. The fact that green procurement criteria are not included in tender or quotation notices helps to explain why this is the case. Appointments that disregard green criteria may result in slow or poor green procurement applications, given that very few of designers were involved in such practices.

However, it is gratifying that almost half the respondents had participated in a green procurement project of some sort or another, which shows that the practice has spread within the regional offices considered.

Lack of client commitment or readiness with regard to green procurement was found to be the number one barrier, followed by the client's lack of knowledge of green procurement in the Department. More capacity building for departmental staff is needed so that green procurement projects may be more fully implemented in the Department. Capacity building is well suited for the practice of GGP (Geng & Doberstein, 2007). The authors affirm that capacity building is a vital necessity for the effective planning and management of GGP, and should comprise several elements: reinforcing managerial systems, employees and institutions (both intra and inter-sectoral), the development of appropriate methods for facilitating community involvement, increased interaction and collaboration between all stakeholders, and the promotion of policies to govern green procurement.

6.8 Implications of the results

6.8.1 Identify policies, legislation and regulations enabling green procurement

The study found that legislation, regulations and policy instruments are in existence in the Department to compel green procurement. However, the determination of whether or not to implement green procurement is driven by the client rather than by legislation, regulations and policies.

The presence of these statutory instruments alone seems insufficient. Awareness of and adherence to these regulations would certainly enforce and increase green

procurement in the Department. Failure to increase training and awareness will continue to yield lacklustre results. Where green procurement stipulations are made part of every contract, the failure to implement such ought to result in the termination of contracts.

6.8.2 The extent to which the designers practise green procurement

Highest number of designers were involved in GP projects in Polokwane and Nelspruit regional offices of Department of Public Works.

- a. 'Energy saving' was the main focus for green procurement projects in the Department. If this were increased it could result in massive savings and a move away from coal dependence in the country, resulting in greater use of 'clean' energy sources.
- b. The client was established as the stakeholder with the greatest ability to enforce green procurement in the Department's construction projects. The status and strength of green procurement may be enhanced if more in the Department were aware of its many benefits.
- c. The lack of green procurement criteria in the Department's tender and quotation advertisements impacts negatively on the status of green procurement. Consultants without green procurement knowledge will be appointed, resulting in resistance, slow applications, poor designs and disregard for environmental considerations, and a failure to uphold South Africa's pledge made at the World Summit.
- d. The status of green procurement practice is that is applied 'occasionally or sometimes'.
- e. Green procurement ought to embrace all the stages of construction projects, as attested to in the literature. The client should enforce compliance so as to avoid non-compliance at later stages.

6.8.3 Lack of client commitment or readiness

Lack of client commitment or readiness with regard to green procurement was ranked as the number one barrier in the Department. This suggests the need for capacity building for both client and designers with a focus on green procurement implementation. This barrier should not be experienced in the Department, considering that legislation, regulations and policies exist.

Unless this is done, environmental degradation will persist and designers' knowledge of green procurement will remain stagnant, with implications for the next generation.

6.9 Recommendations from the study

The Department of Public Works should implement measures to strengthen its capacity to enforce green procurement legislation, regulations and policies related to tenders and quotation specifications when sourcing external consultants. The lack of green procurement criteria in the Department's tender and quotation advertisements impacts negatively on the status of green procurement. Consultants without green procurement knowledge will be appointed, resulting in resistance, slow applications, poor designs and disregard for environmental considerations. Literature revealed that legislation, regulations and policies are the drivers of green procurement in developed countries and therefore governments can use the top-down approach to urge stakeholders to adopt GP practices. The same should be applied to enforce compliance in all stages of construction projects. Green procurement practices should be applied across departmental projects and ought to embrace other aspects of sustainability. The Department should consider strengthening employees' capabilities through mandatory training programmes. These should include staff at every level – top management, those who put together project specifications, and everyone else in the construction project value chain. This would immediately raise the profile of green procurement and is likely to result in better and more environmentally sound decisions being made.

The Department of Public Works should consider improving the current status of GP practise at the design stage of construction projects from 'occasionally or sometimes'

(3) to frequently use (5). Designers in majority agreed in question 18 (Likert scale) that green procurement was practised 'occasionally or sometimes' (3).

The Department of Public Works should invest substantially on overcoming obstacles to GP practice as encountered by architects and other designers at the design stage of its projects. The respondents viewed lack of client commitment or readiness followed by client's lack of knowledge as the major barriers. These barriers are associated with resistance to change. In order to defeat such obstacles, literature point out that motivation of employees is warranted when resistance to change is encountered; employers should encourage workers to see the advantages of fresh procedures and habits. Organisations need to be aware of resistance to change and take steps to reduce its impact.

6.10 Suggestions for future studies

This study has revealed areas where further investigation may be warranted. An apparent discrepancy exists in that legislation, regulations and policies instruments are in place in the Department but the main determiner of whether or not green procurement is practised remains the will of the client, and not the legislation. Further investigation could be conducted into what green procurement policies, legislation and regulations exists and are relevant for the design of green procurement projects in the National Department of Public Works.

In addition, further study could be conducted into green procurement practices at the construction stage in provincial Departments of Public Works.

6.11 Concluding remarks

The findings of the study are that green procurement is occasionally practised at the design stage of construction projects within the Department of Public Works. In total thirteen (13) green procurement drivers and fifteen (15) barriers were uncovered from literature; it may be concluded that the previous dearth of knowledge on this topic has been at least partially overcome.

The main driver of green procurement – legislation, regulations and policies – exists and is in place in the Department of Public Works. However, implementation generally relies on the client rather than on this driver. It is the awareness, knowledge and will of the client that ultimately drive green procurement.

Green procurement does not enjoy a high status in projects of the Department. Barriers exist, mostly in the form of the lack of knowledge and commitment from both clients and designers. The fact that the main driver of green procurement – legislation – is in place should aid the National Department of Public Works to improve on the rate of green procurement at all stages of projects. In addition, there is a need for capacity building for client and designers with regard to environmental protection and green procurement.

The study reviewed literature covering the success narratives of developed nations regarding green procurement practices, along with the current status in developing countries, including South Africa. Green procurement is still a fairly latest notion in South Africa and continues to receive more attention from academia and the private sector than from government. The recycling of water is starting to become a feature of operations in the private sector, rather than in the public sector, which is unfortunate. The researcher recommends that municipalities and other government institutions in South Africa emulate the example of Japan in this regard. There is still a need to spread the concept in the public sector. In this area the study concurred with previous studies which revealed that implementation in developing countries is still poor, despite some notable initiatives. Implementation of green procurement ought to embrace the entire lifecycle of a construction project from client request to disposal and use of the structure. Successful implementation requires co-operation and collaboration from all stakeholders, right from the time of a project's inception to the final handover of a building and its subsequent use.

With full commitment to the concept and principles of green procurement, the building industry could make a meaningful beneficial influence on the area of environmental protection along with sustainability.

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