

Environmental attitudes of architects as a driving force for considering sustainable designs

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ABSTRACT

Environmental attitudes (EA) comprise a person's favourable or unfavourable perception and beliefs towards the natural environment and its quality. The EA of a person can influence and foster pro-environmental behaviour. Within the construction industry, architects are the main decision-makers regarding the design of an architectural project and their design decisions could have a positive or negative impact on the condition of the natural and built environment. Architects have a responsibility towards stewardship of the natural environment in such a way that the environmental impact of architectural projects should be minimised by creating sustainable architectural designs. However, the EA of an architect can influence the extent to which environmental sustainable design methods are considered and incorporated. This research study aimed to (i) determine the EA of South African professional architects (ii) as well as the extent to which architects consider incorporating sustainable design methods into the designs of architectural buildings and (iii) to gain an understanding of whether there is impact of EA on the decisions they make regarding considering sustainable design methods to create a more sustainable built environment which is beneficial to humans and to the larger society. As data collection method, a questionnaire was used to determine the EA of the participants, by means of using the revised shortened Environmental Attitudes Inventory (EAI) as well as the extent to which sustainable design methods were considered. All the collected data was statistically analysed and summarised and it was found that the architects had concerned EA towards the natural environment and that the architects did consider incorporating sustainable design methods. However, the concerned EA of the architects did not serve as a driving force for considering sustainable design methods.

Key terms: Architect; environmental attitude (EA); sustainable design; sustainable design principles; pro-environmental behaviour; preservation; utilisation; Environmental Attitudes Inventory (EAI).

OPSOMMING

Omgewingsingesteldheid is 'n persoon se gunstige of ongunstige persepsie en oortuiging teenoor die natuurlike omgewing en die gehalte daarvan. Die omgewingsingesteldheid van 'n persoon kan omgewingsvriendelike gedrag beïnvloed en aanspoor. In die konstruksie industrie is argitekte die hoof besluitnemers oor die ontwerp van 'n argitektoniese projek en die argitek se ontwerpbesluite kan 'n positiewe of negatiewe impak hê op die toestand van die natuurlike- en bou-omgewing. Argitekte het 'n opsigtersverantwoordelikheid teenoor die natuurlike omgewing, wat behels dat die omgewingsimpak van argitektoniese projekte beperk moet word deur volhoubare argitektoniese ontwerpe te ontwikkel. Die omgewingsingesteldheid van 'n argitek het egter 'n invloed op die mate waartoe omgewingsvolhoubare ontwerpmetodes oorweeg en geïmplementeer word. Die navorsing poog om (i) die omgewingsingesteldheid van Suid-Afrikaanse professionele argitekte te bepaal (ii) asook om te bepaal tot watter mate argitekte volhoubare ontwerpmetodes in die ontwerp van 'n argitektoniese geboue oorweeg en (iii) om te verstaan of die omgewingsingesteldheid die besluite rakende volhoubare ontwerpmetodes beïnvloed om sodoende 'n volhoubare bou-omgewing te skep wat voordelig is vir mense en die gemeenskap. Vir data-insamelingsdoeleindes, was 'n vraelys gebruik om die omgewingsingesteldheid van die deelnemers te betaal asook die mate waartoe volhoubare ontwerpmetodes oorweeg word. Die data was statisties geanaliseer en opgesom en die bevinding dui daarop dat die argitekte besorg is oor die natuurlike omgewing en dat hulle oorweeg om volhoubare ontwerpmetodes te inkorporeer. Die besorgde houding van die argitekte het egter nie as motiverende faktor gedien om volhoubare ontwerpmetodes te oorweeg nie.

Sleutel terme: argitek; omgewingsingesteldheid; volhoubare ontwerp; volhoubare ontwerpbeginsels; omgewingsvriendelike gedrag; bewaring; benutting; omgewingsingesteldheid indeks

LIST OF ABBREVIATIONS

DEAT:	Department of Environmental Affairs and Tourism
EA:	Environmental Attitudes
EAI:	Environmental Attitudes Inventory
ECS:	Environmental Concern Scale
GBSA:	Green Building Council South Africa
MBA:	Masters of Business Administration
MORA:	Model of Reasoned Action
NECP:	New Ecological Paradigm
NEP:	New Environmental Paradigm
PBC:	Perceived Behaviour Control
SA:	South African
SACAP:	South African Council for the Architectural Profession
SAIA:	South African Institute of Architects
SPSS:	Statistical Package for Social Sciences
TPB:	Theory of Planned Behaviour
VCN:	Value Belief Norm

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CHAPTER 1

INTRODUCTION AND PROBLEM STATEMENT

1.1 INTRODUCTION

Chapter 1 provides a brief introduction regarding the background of this research study which led to the development of the problem statement, followed by the associated research objectives, the research method used to achieve the set objectives and an overview of the dissertation's structure.

1.2 BACKGROUND OF THE RESEARCH

Throughout history humans have been in interaction with the natural environment, the type changing over the centuries from living off the land to altering and damaging the environment. This left a permanent environmental impact (Hughes, 2006:39), but creating a built environment is an integral part of living. As a result, the natural environment has changed (Bartuska, 2007:3; Miller & Burr, 2002:1).

The industrial revolution of the 18th century made a prominent environmental impact, with the human population expanding substantially as technological inventions advanced and increased rapidly (Du Pisani, 2007:84,87; Miller & Burr, 2002:1). Changes in the natural and built environment occurred as the human population continued to grow, urbanisation increased, natural resources were over-exploited, pesticides were introduced; and agriculture areas expanded. This human behaviour placed pressure on the environment which had an impact on various levels such as deforestation, loss of biodiversity species, degradation of ecological quality, pollution, natural resource exhaustion and environmental fragmentation (Miller & Spoolman, 2012:17). The availability of environmental services is crucial on a social level because meeting the needs of individuals and societies depend on it. Natural resources are also crucial to sustain the economy of a country (Heberlein, 2012:4). The unsustainable

human behaviour escalated to the extent that environmental degradation became prominent, visible and unavoidable (Milfont, 2007:4).

From the late 1960s to the early 1970s, awareness of environmental conditions grew with concern for the environment and its quality (Du Pisani, 2006:89). In 1972, on an international level, the United Nations organised a conference in Stockholm with the aim of guiding preservation of the environment. A Stockholm report stated that: “A point has been reached in history when we must shape our actions throughout the world with a more prudent care for their environmental consequences.” All individuals, organisations and governments were strongly urged to act responsibly and to preserve environmental quality by any small or large-scale means possible (United Nations, 1972:3).

Governments, organisations and industries started prioritising environmental preservation through innovation projects, technologies, programmes and remedies (Carlson, 2004:2). These were explored, developed, tested and implemented in an attempt to address the environmental crises at hand and to preserve nature and the Earth for future generations (Du Pisani, 2006:87; Heberlein, 2012:4). Maloney and Ward (1973:583) and Dunlap *et al.* (2000:431) argue that environmental issues are a result of human behaviour embedded in anthropogenic beliefs of dominance over nature and meeting human needs through using the environment. Therefore, all types and scale of attempts made towards environmental preservation are noble but simultaneously require change in human behaviour and thinking (Heberlein, 2012:4; Maloney & Ward, 1973:583; Ragheb *et al.*, 2016:778). According to Eilam and Trop (2012:2213), and Milfont and Duckitt (2004:289), if change in human behaviour could occur and individuals take responsibility for their behaviour and act environmentally, sustainable change and improvement in environmental issues could occur on a societal level. However, environmentally unsustainable human behaviour begins with changing decisions which sprout from feelings or attitudes towards the natural environment (Milfont, 2007:ii). Schlegelmilch *et al.* (1996:35) found that as people became aware of environmental issues a change in their environmental attitude (EA) occurred. McIntyre and Milfont (2016:95) agree and stress the importance of assessing the EA of individuals as pro-environmental behaviour can be fostered.

1.3 PROBLEM STATEMENT

The construction industry consumes extensive natural resources and is one of the largest polluters, which subsequently has a major impact on the environment (Ding, 2008:463). The sourcing of raw materials, the manufacturing process and transportation of construction materials required to create buildings extends from extensive energy and water consumption, pollution and waste generation throughout the life-cycle of an architectural project (Du Plessis, 2002:13-15). The research behind this paper aimed to investigate the root cause of the problem by exposing the gross oversight of EA within the architectural design industry.

According to Ding (2008:463) and Ragheb *et al.* (2016:778), architects have recognised that a change in human thinking is required as the construction industry uses an extensive amount of natural resources. For Erdoğan (2009:1024), within various professional fields related to the construction industry there lies a responsibility of environmental stewardship and sustainable planning. Architects are decision-makers regarding designs in the construction industry and have an impact on the condition of the natural and built environment (Jones, 2006:23; Loftness *et al.*, 2007:965). Therefore, they have a responsibility to plan, design and explore innovative solutions and remedies to implement and construct sustainable buildings (Erdoğan 2009:1024). This must be done by integrating political, environmental and economic requirements into architectural projects (Erdoğan 2009:1024; Ugwu & Haupt, 2007:665).

Heberlein (2012:5) argues that a person's perception and attitude towards the natural environment can potentially influence sustainable solutions and foster ecological behaviour. Milfont and Duckitt (2004:289) strongly argues that change in human behaviour can have a great effect on addressing and improving environmental issues. In order to create change in behaviour it is necessary for the intentions people hold to change, notably in attitudes to an object or situation (Pryor & Pryor, 2005:5).

Ding (2008:451) and Lee (2012:77) emphasise the importance of incorporating sustainable design methods into the design stage of an architectural project to help minimise the environmental impact, whether for a single building or a larger

development. The main role of architects is to create designs and if appropriate methods are incorporated then a sustainable building would be constructed (Loftness *et al.*, 2007:965). As architects are in the position to influence the environmental impact a project will have during its construction and life-cycle by incorporating sustainable methods it is therefore important to explore the EA of professional architects. This will be used to gain an understanding of whether it influences the decisions they make regarding considering sustainable design methods to create a more sustainable built environment which is beneficial to society.

1.4 RESEARCH AIMS AND OBJECTIVES

The aim of this research study is to explore the EA of South African architects as a driving force for considering sustainable methods into the design of an architectural building and project. To achieve the aforementioned aim, the following objectives are set:

- i Determine the environmental attitudes of the architects through applying the environmental attitudes inventory (EAI).
- ii Determine the extent to which architects consider incorporating sustainable design methods into the designs of architectural buildings.
- iii Establish the relationship that exists between EA and considering sustainable design methods.

1.5 CLARIFICATION OF IMPORTANT TERMS

The following definitions will be used throughout the dissertation:

- i **Environmental Attitudes (EA)**, as defined in chapter 2, refers to an individual's general perception, evaluation, orientation, affection, behavioural intentions or beliefs towards the natural environment, environmental issues and the quality of the environment (Milfont, 2007:ii).

- ii **Environment** refers to the natural external environment which consists of living and non-living organisms as well as natural elements such as rivers, seas, landscape area, habitats, soil, vegetation, micro-organisms, mountains, lakes and the atmosphere (Carlson, 2004:5).
- iii **Built environment** refers to an area or space in which a wide range of architectural structures, sculptures, features, buildings and spaces are created, established and modified by humans for a certain function (Bartuska, 2007:5; Srinivasan *et al.*, 2003:1446).
- iv **Healthy built environment** enhances learning, productivity and human well-being. A healthy built environment is an area or space in which people enjoy spending their time, in comfort and safety (Halliday, 2008:ix; McClure & Bartuska, 2007:ix; McLennan, 2004:46-49).
- v **Principal architect** is the leading professional architect on the project. This person is responsible for vetting and approving all design decisions alongside the client.
- vi **Professional architect** is registered with South African Council for the Architectural Profession (SACAP) and has a high level of training and authority to partake in the design process of various types and complexities of projects. He or she is authorised to make important architectural design decisions and to supervise the construction process of an architectural project (SACAP, 2013:30).
- vii **Professional senior architectural technologist** is a person registered with the SACAP who has a high level of technical competency. This person can create an architectural design, perform related administration and co-ordinate activities (SACAP, 2013:30).
- viii **Sustainable design**, as defined in chapter 2, refers to the philosophical design process which entails creating an architectural design that: “results in a sustainable building which is ecologically balanced, humane and viable over the life-cycle. Sustainable designs optimize the utilisation and integration of natural elements (e.g., day lighting, solar heating and natural ventilation) and

technologies to provide human comfort and to limit exhaustion of natural resources” (Loftness *et al.*, 2007:965).

1.6 RESEARCH METHODOLOGY

To gain an understanding regarding what EA entails and the role it plays in influencing sustainable design decisions, a literature study will be conducted. Existing literature was acquired through a *Google* and *Google Scholar* search which included applicable academic journal articles, textbooks and online academic databases (such as *ScienceDirect* and *EbscoHost*). The literature review focusses on the following key terms:

- i Architect
- ii Attitude
- iii Environmental Attitude (EA)
- iv Sustainable design
- v Sustainable design principles

A positivistic research paradigm was adopted for this research study and a survey used which allowed me to reach a large population group in a short period. The target population group for this study were defined as actively practicing South African professional architects and professional senior architectural technologists registered with SACAP who fulfil the responsibilities of a principal architect on projects. A convenient sample was used as the questionnaire was distributed by SACAP and SAIA to architects registered on their database. In addition, the questionnaire was distributed to participants with an active *LinkedIn* and e-mail account.

A self-administered questionnaire was used for data collection through *Google Forms*. It consisted of three sections, namely section 1 (Individual background information); section 2 (Environmental Attitudes Inventory scale); and section 3 (sustainable design methods). Section 1 consisted of multiple-choice and fill-in questions. Section 2

provided a four-point Likert scale ranging from *strongly agree* (1) to *strongly disagree* (4). The responses of section 3 were also measured through means of a Likert scale but the ranges entailed one being *always* and four being *never*. A covering letter was included with the questionnaire to provide an explanation of the research aim and the nature of voluntary participation. Relevant contact details were provided and the participants were reassured about confidentiality. A total of 279 questionnaires were successfully completed, of which 204 met the population group criteria and could be used for this research study. These responses were statistically analysed through using the Statistical Package for Social Sciences (SPSS) version 24 which comprised of descriptive statistics, reliability and correlation analysis.

1.7 CHAPTER OUTLINE

The chapters of this dissertation will be divided as follows:

Chapter 1: Introduction and problem statement

Chapter 1 has provided a brief introduction as well as background context relevant to this research study. The formulated problem statement was discussed along with the research aim and objectives set to explore the problem statement.

Chapter 2: Environmental attitudes and architecture

In chapter 2, an extensive review of existing literature applicable to this research study will be provided. The definition of EA will be formulated, followed by the structure embedded in it and how it influences environmental behaviour. The various measurements available to assess EA will be briefly discussed with a focus on the Environmental Attitudes Inventory (EAI). The chapter will examine the role of architects as well as the environmental impact of architecture. This will be followed by an overview of the various definitions regarding sustainable design which will lead to the exploration of the principles embedded in sustainable design.

Chapter 3: Research methodology

Chapter 3 will present the research methodology adopted for this research study with focus on the research paradigm chosen. The process followed to use and implement a survey to obtain the research data will be elaborated upon.

Chapter 4: Description of the results

In this chapter, the research results obtained from the questionnaire will be stated and analysis of the data briefly described.

Chapter 5: Discussion and conclusion

The final chapter will consist of a thorough discussion of the research results which will lead to the conclusion drawn from this research. The limitations encountered during the research will be briefly stated and recommendations made for future research studies.

1.8 SUMMARY

In this chapter, background information was provided along with the problem statement which led to the formulation of the associated research aim and objectives. Important terminology relevant to this research study was briefly defined. An overview of the research methodology was followed by the structural layout of this dissertation. The next chapter presents a review of literature regarding the concept of environmental attitudes and sustainable designs.

CHAPTER 2

ENVIRONMENTAL ATTITUDES AND ARCHITECTURE

2.1 INTRODUCTION

Based on the objectives set out in chapter 1, this chapter will review literature regarding the concept of Environmental Attitudes (EA), the purpose it has in human life and the role it plays in human behaviour. The history of architects and their role will briefly be explored, with focus on sustainable design and what it entails.

2.2 ATTITUDES

Since a key component of the concept of “Environmental Attitudes” (EA) is the term “attitude” (Milfont, 2009:237) it is important to explore briefly its etymology. It originates from two Latin words, “aptus”, which means “ready for action, fitness or adaptedness” and “apto”, which refers to the meaning that can be portrayed through body posture. During the 18th century, the meaning was associated with a physical position or orientation in relation to or correspondence with a frame of reference. In the 1860s the term was introduced into the field of psychology and social psychology, since when it has become a major area of research interest (Eiser, 1986:11), associated with the internal preparation process that occurs towards taking action (Cacioppo *et al.*, 1994:261; Allport, 1935:799).

Carlson (2004:15) notes that attempts have been made to define attitude within various social science disciplines, the first by Sir Francis Galton who approached it as a physical orientation which could be measured through observation of the way a person orientated his or her body towards another. Louis Thrustone argued that attitude derived from a set of affective perceptions rather than a physical orientation, and in 1928 released a pioneering paper titled “*Attitudes can be measured*”. Subsequently the term evolved to describe a feeling held towards a stimulus (Cacioppo *et al.*, 1994:261).

Allport (1935:806-822) built on the theory of Thrustone, and suggested that attitudes are forms of mental readiness influenced by experiences that bring about a direct or dynamic behavioural response. Behaviour was thus considered as a response provoked by a stimulus and attitude was considered as a persistent disposition arising from it. Therefore, based on the responses received, conclusions could be drawn about what the attitude would be towards the stimulus and the meaning behind the behaviour could be determined. Berkowitz (1975:168) proposed an alternative definition and approach in describing attitude as a positive or negative feeling evoked by a specific object, situation or issue. He argued that the degree of favourableness or unfavourableness was influenced by the feelings held by a person. Therefore, attitudes consist of an evaluation process regarding the extent to which an object or issue is liked or disliked. Eiser (1986:11) and Milfont (2009:237) agreed with the approach of Berkowitz, defining attitudes as feelings of like or dislike, approval or disapproval, attraction or repulsion or even trust and distrust held towards an object, oneself, other people or issues. These feelings would often be presented through a person's actions, reactions or words.

For the purpose of this study, attitudes will be defined as comprising an evaluative judgement of favour and disfavour, or like and dislike towards an object, situation, problem or person. The judgement is derived from affective, cognitive and behavioural information (Maio & Haddock, 2015:4).

2.3 ENVIRONMENTAL ATTITUDES

Environmental Attitudes (EA) comprises one of the various concepts that have been researched within the field of Environmental Psychology since the 1960s, with one main focus area revolving around the complex interaction between humans and the natural environment. It involves an understanding of the psychological roots behind environmental degradation and the motivation behind pro-environmental behaviour (Kollmuss & Agyeman, 2002:240). Other research topics linked to EA include research about environmental awareness, beliefs, concerns and "green" consumer behaviour (Ewert & Galloway, 2004:1). According to Bamberg (2003:21) and Milfont (2007:5),

other research studies are focused on formulating a precise definition for environmental concern, creating an understanding of the factors that give rise to the existence of environmental concern and establishing whether there is a connection between environmental concern, EA and pro-environmental behaviour.

According to Milfont (2007:ii), EA can be defined as an individual's general evaluations, orientations, perceptions, affections, behavioural intentions or beliefs towards the natural environment and environmental issues. In addition to Milfont's perspective, Heberlein (1981:5) expands on this concept through defining it as an all-inclusive fondness, dislike, favourable or unfavourable evaluation held towards aspects of the environment, the whole of the environment or object that has a visible impact on the quality and standard of the environment (Heberlein, 1981:5; Milfont, 2009:235; Milfont & Duckitt, 2004:289). This definition includes a cognitive, affective, behavioural intention and evaluative orientation a person has regarding environmental issues and activities (Milfont, 2007:11).

Environmental Concern is a synonym used in research regarding EA and refers to the extent to which people are aware of environmental issues. Those who are concerned with the condition of the environment support motions which aim to address environmental issues and are willing to contribute to and participate in the solutions. Environmental concern can further be defined as the affection and emotional response related to beliefs held towards environmental issues, however, EA is a more appropriate term to use, as environmental concern is an inclusive component of it. EA is also the preferred term used and found in environmental psychology literature (Milfont, 2007:11).

The validity of such EA definitions was questioned by Bamberg (2003:21), who argued that the term included a broad spectrum of environmentally related emotions, perceptions, values, attitudes, knowledge, attitudes, values and behaviour. As a result, environmental concern/attitude could be defined under the umbrella of a general definition of attitude that included a cognitive and affective evaluation (Breckler, 1984:1191-1192; Carlson, 2004:16). Carlson (2004:43) defines EA as "a psychological tendency developed in a natural environment, and associated feelings of distress or worry, which may be accompanied by supporting behaviour", whilst others have

regarded it as a favourable or unfavourable evaluative perception towards the natural, non-human and bio-physical environment. It may include the affect and beliefs a person holds towards factors that influence the quality of the environment (Milfont, 2009:235; Milfont & Duckitt, 2004:289).

Regardless of the complexities in developing a definition, for the purpose of this research study EA will be defined as an individual's general perceptions, evaluations, orientations, affections, behavioural intentions or beliefs towards the natural environment, environmental issues and the quality of the environment (Milfont, 2007:ii).

2.3.1 Purpose of environmental attitudes

An individual's favourable or unfavourable orientation towards the natural environment can be determined but the question is raised regarding its purpose. For Milfont (2009:243-247) it provides an understanding, social-identity and protective function which might occur in various combinations at certain times. In this section, the psychological purpose of EA in an individual's life will be briefly discussed.

2.3.1.1 Making sense of the world

EA help people make sense of the built and natural environment through obtaining knowledge and bringing forth an evaluative summary. They provide confirmation and re-assurance regarding one's understanding of the surrounding environment and one's role and function or place in it. An example would be when people hold different preferences towards living in a house rather than an apartment, or why some people prefer being in nature and other prefer being in urban settings (Milfont, 2009:244).

2.3.1.2 Express values and establish self-identity

EA serve a social-expressive function which enable people to convey and articulate the values and beliefs they hold toward the natural environment and related issues. As

a result, social interactions occur and a sense of acceptance from others is experienced. The expression of values fulfils the need people have for self-disclosure and shaping their identities (Milfont, 2009:244; Ennis & Zanna, 2000:397).

2.3.1.3 Protective function

EA fulfil a protective function in the sense that it defends one against internal conflicts and anxieties and assists individuals in coping with and making sense of intra-psychic conflicts that exist due to threatening environmental conditions. If the natural and built environments are perceived as threatening and dangerous then EA assist in protection and coping with these threats (Milfont, 2009:244).

2.3.2 Environmental attitudes structure

The tripartite model suggests that attitudes are a response to a stimulus and consist of three types of response components (affective, behavioural and cognitive) towards stimuli which fluctuate in severity and direction (Figure 2-1). The affective component embeds the emotional reaction which varies between a pleasurable and unpleasurable emotion. The behavioural component relates to overt actions, verbal expressions and intentions, showing favourable or supportive behaviour towards an object and manifesting unfavourable or disregarding behaviour. The final component is cognitive, which refers to thoughts, knowledge, beliefs and perceptions a person has about a certain attitude object, from favourable to unfavourable. (Breckler, 1984:1191-1192; Carlson, 2004:16).

Carlson (2004:16) explains that in the tripartite model (illustrated in Figure 2-1) attitudes are an intervening factor between the stimuli and the affective, behavioural and cognitive components.

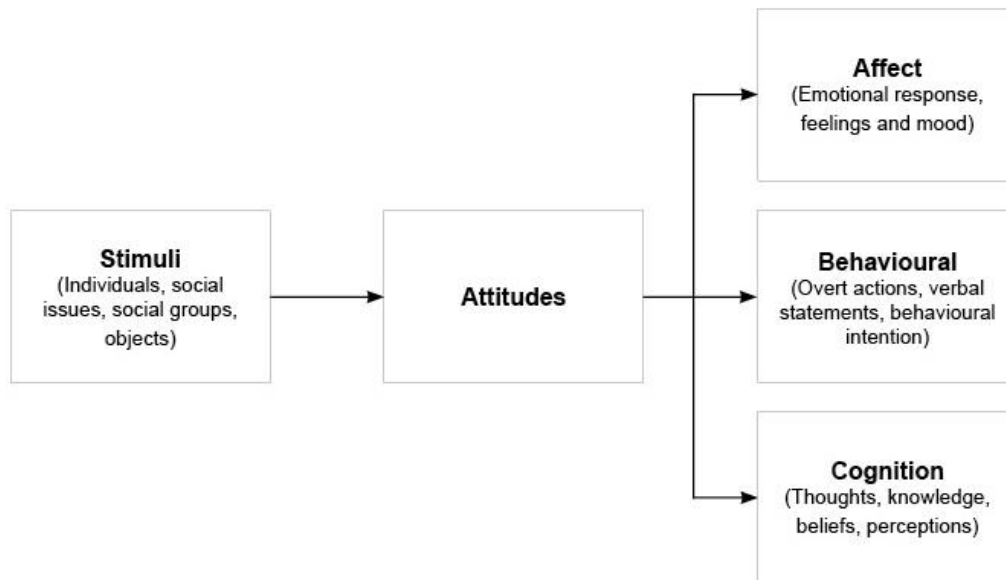


Figure 2-1: Tripartite model (Breckler, 1985:1192)

Milfont (2009:239) argues that the tripartite model is a traditional one used to explore and understand the structure of attitudes which also include those towards the environment. However, Milfont and Duckitt (2004:299) suggest that EA consist of multiple dimensions because of the extensive and broad perceptions related to the natural environment. Attitude is revealed and conveyed within several dimensions and the way that these are related can be evaluated. The EA are also considered to be inherently hierarchical in nature as the dimensions that underlie the attitudes are rooted in values. The hierarchical nature and multi-dimensionality are respectively manifested within a horizontal and vertical structure (Milfont, 2009:240; Heberlein, 1981:241). Milfont (2007:187-189) explains that the horizontal structure embeds twelve specific dimensions that explore the perceptions and beliefs held towards natural environments, as shown in Figure 2-2. These various dimensions shape the core of the overall horizontal structure of the EA, with a vertical structure consisting of two correlated second-order factors, preservation and utilisation. Preservation indicates that it is important to preserve and protect nature along with the various species of fauna and flora which co-exist in the environment. In contrast to preservation, utilisation refers to a belief that nature and these species can be altered and used to fulfil the needs of humanity (Milfont, 2007:187-189).

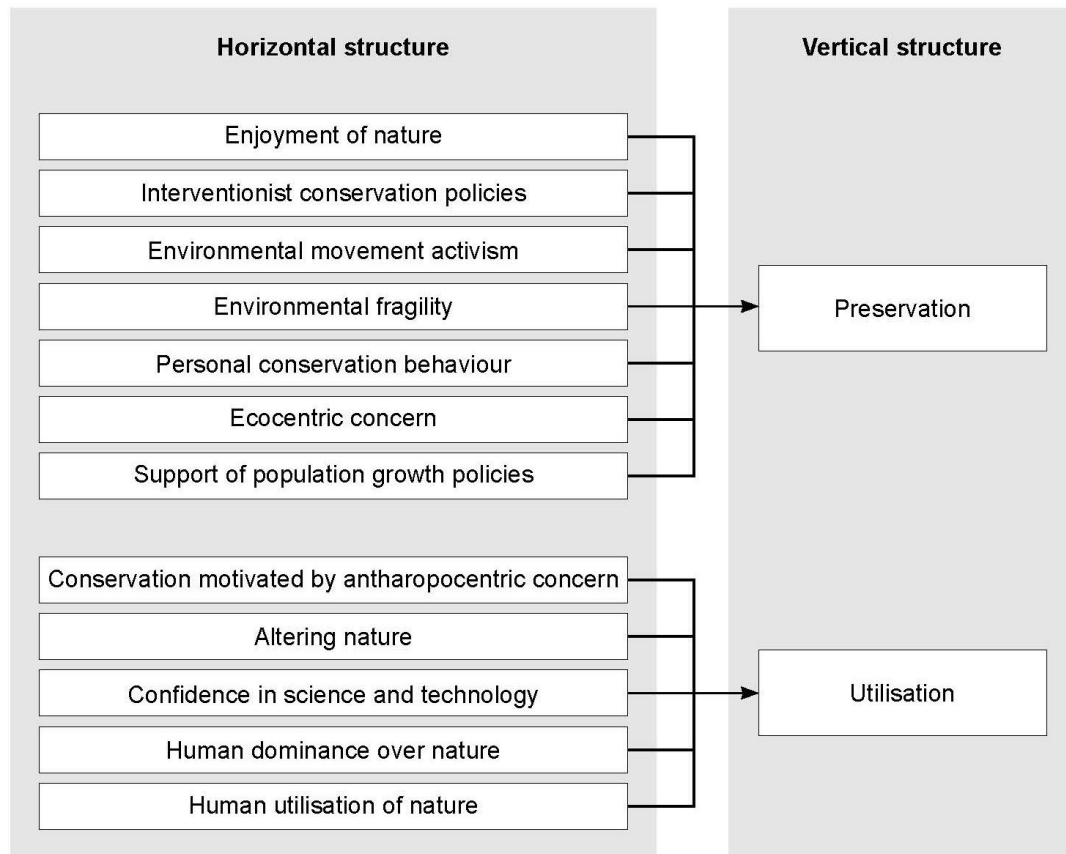


Figure 2-2: Horizontal and vertical structure of EA (Milfont, 2007:93)

2.3.3 Relationship between attitude and pro-environmental behaviour

According to Kollmuss and Agyeman (2002:240), pro-environmental behaviour consists of acts or deeds performed with the purpose of limiting possible negative environmental effects that might result from the behaviour. Pursuing the goal to explain the relationship between EA and whether they influence a person's ecological or pro-environmental behaviour is challenging, because the performed behaviour of people can contradict their values and views (Ajzen & Fishbein, 2005:174; Ewert & Galloway, 2004:1-2). Various theories and models, such as attitude theory, model of reasoned action and theory of planned behaviour, have been developed to understand the role that attitudes plays in guiding human behaviour (Ajzen & Fishbein, 2005:174).

2.3.3.1 Attitude model

The attitude model developed by Schafer and Tait (1986:3) is based on the notion that attitudes impact on behaviour. Intervening factors such as habits (automatic response), social norms (expectation from social groups) and the expected positive or negative repercussions that follow from the behaviour cause discrepancies between attitudes and the performed behaviour (as shown in Figure 2-3). Attitudes are not considered to be an unchangeable, isolated variable because the beliefs, values and personal needs influence and determine attitude. The beliefs are based on knowledge and information about an object considered to be factual and true. In contrast, values allude to the feelings a person has regarding what is considered to be desirable or undesirable (Fishbein & Ajzen, 1975:218; Schafer & Tait, 1986:3-4). The third component which influences attitudes is personal needs for rewards, defending the ego or self-esteem to protect oneself from threats and to gain an understanding of how to react to the natural environment (Schafer & Tait, 1986:3-4). According to Fishbein and Ajzen (1975:218), attitudes are subject to change in the belief system, however, it should be acknowledged that, depending on the circumstances, behaviour can also, in turn, have an impact on attitudes. In the event that behaviour is performed which is inconsistent with the attitude held, pressure is placed on the person to maintain an attitude which is consistent with the behaviour, and as a result the attitude will change (Schafer & Tait, 1986:5).

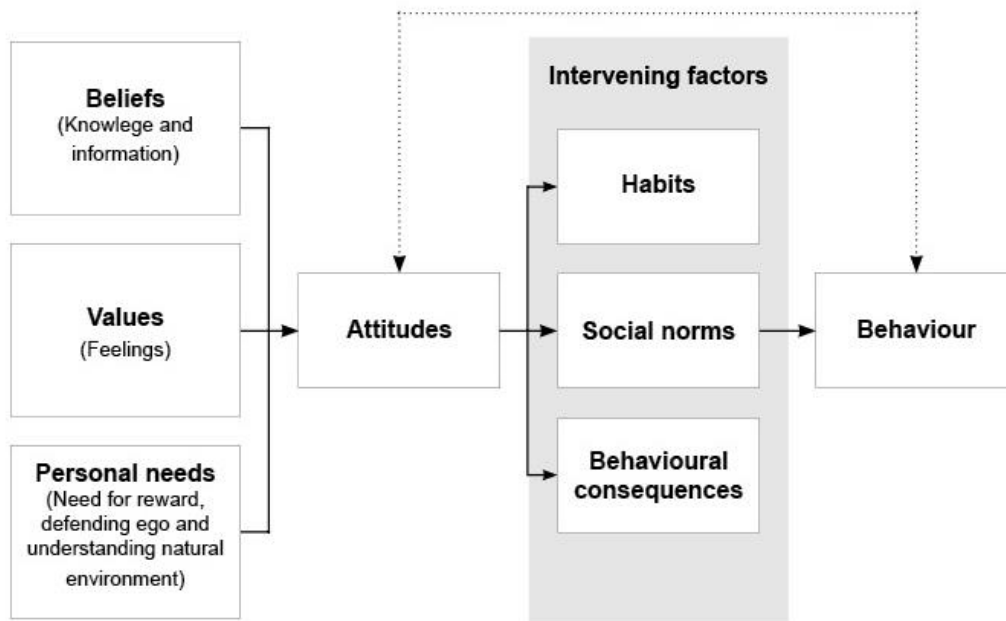


Figure 2-3: Attitude model (Schafer & Tait, 1986:5)

2.3.3.2 Model of Reasoned Action (MORA)

The Model of Reasoned Action (MORA) is a framework that provides assistance in understanding the belief structure that underlies the attitudes and behaviour of people. The two conclusions drawn from this model are that (a) people have false beliefs and through providing accurate information the attitude or belief can change; (b) true beliefs or convictions can potentially influence attitude and behaviour in the desired direction (Pryor & Pryor, 2005:3).

The intentions people have serve as a guide to certain behaviour, however, personal- and social factors influences the human intentions (refer to Figure 2-4). The personal factor refers to a person's attitude towards carrying out a particular act or behaviour. The social factor makes reference to the subjective norm, that is, to the perception people have that other important people might oppose or approve the performed behaviour. The behaviour performed is based upon what other people might think about it (Pryor & Pryor, 2005:4).

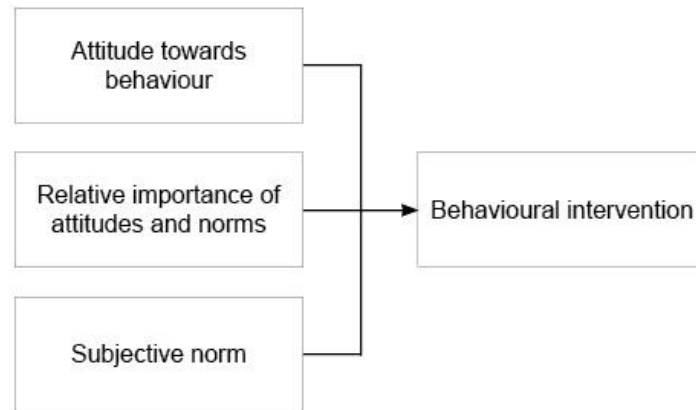


Figure 2-4: Model of Reasoned Action (MORA) (Pryor & Pryor, 2005:4)

2.3.3.3 Theory of Planned Behaviour (TPB)

Ajzen's theory of Planned Behaviour (TPB) is based on the MORA theory, addressing limitations regarding the notion that people do not have complete control over their behaviour. The main similarity between both is that they assume that the planned behaviour is driven by intentions (Ajzen, 1991:18). Contributory factors play a role in executing pro-environmental behaviour that can be explored and explained (Greaves *et al.*, 2013:110), with an assumption that a person's behaviour is based on beliefs, attitude and intentions (Ajzen & Fishbein, 2005:174). According to Ajzen (1991:181), the strength of the intention plays a crucial role in performing a certain behaviour. However, the intention influences the person's willingness to make an effort to execute a certain behaviour which is influenced by attitude towards the behaviour, the evaluation of the subjective norm and the person's perceived behaviour control (PBC) (Ajzen, 1991:179; Greaves *et al.*, 2013:110; Kaiser *et al.*, 1999:9;) The actual behaviour depends on these intentions as well as the perceptions of behaviour control (refer to Figure 2-5) (Ajzen, 1991:184).

Attitude, subjective norms and perceived behavioural control include certain salient beliefs which cause discrepancies in behaviour (Greaves *et al.*, 2013:110). The salient beliefs influence the intentions and action of a person (Ajzen, 1991:189). Attitude towards behaviour is based on the person's assessment about whether the outcome

or result of a certain behavioural act will be favourable or unfavourable (Ajzen, 1991:188). Attitude towards behaviour is influenced by behavioural beliefs that refer to the person's evaluation about what the outcome of the behaviour will be. Additional factors associated with the outcome of the behaviour are also taken into consideration, for example, cost implications. The positive or negative evaluation of the behavioural outcome and contributory factors shape the attitude towards the behaviour (Ajzen, 1991:191).

Subjective norm is the perceived social pressure a person experiences in performing a certain behavioural act, however, the behaviour is based on the perception that significant groups or other people expect that certain behaviour be performed and performed with the aim of gaining appraisal (Ajzen, 1991:188; Greaves *et al.*, 2013:110). The subjective norm is influenced by the normative belief that behaviour will be performed based on the approval or disapproval judgement of significant others (Ajzen, 1991:195). Perceived behaviour of control is the person's perception about whether it is possible to perform the specific behavioural act. It is based on the person's evaluation of whether they have the ability, self-efficiency, opportunity and resources to execute the actual behaviour. In addition, the evaluation of the level of difficulty or the amount of effort required to perform the behaviour also plays a critical role (Ajzen, 1991:182-183; Greaves *et al.*, 2013:110). The perceived behaviour of control is based on the control beliefs the person takes into consideration. Factors such as experience, availability of resources, information gained about the behaviour and the right opportunity influences the person's control beliefs. Therefore, if a person concludes that he or she can perform the behaviour and has the required resources to overcome obstacles, there is a greater sense of control over the behaviour (Ajzen, 1991:196).

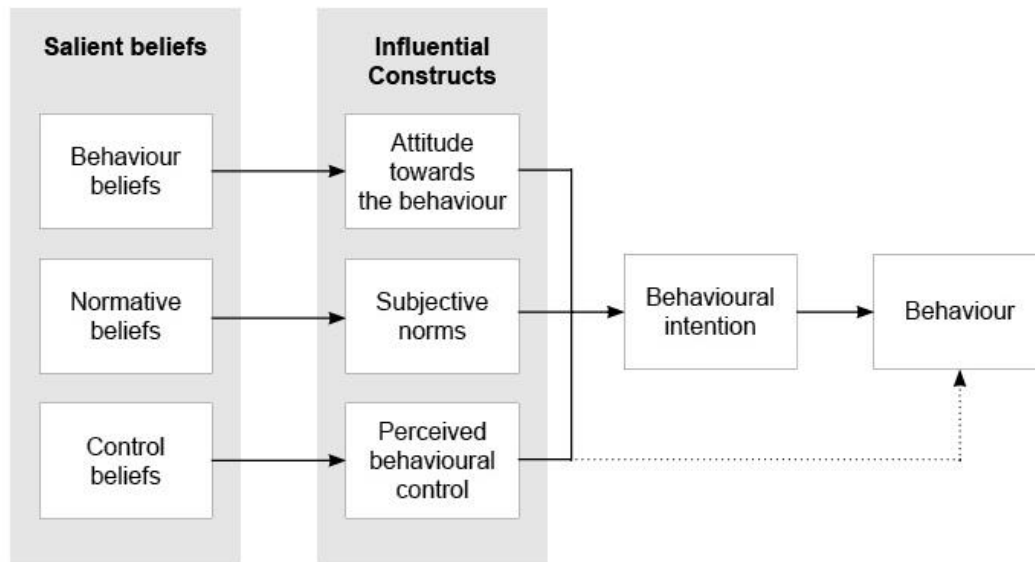


Figure 2-5: Theory of Planned Behaviour (TPB) (Ajzen, 1991:182)

2.3.4 Rational for pro-environmental behaviour

The Value Belief Norm (VBN) argues that people perform pro-environmental behaviour once the repercussions of environmental impose a threat to egoistic, social altruistic and biospheric objects which people value. With egoistic values people will take the necessary actions to protect the environment once they are personally affected, for example, lifestyle, future and health, by environmental harm or issue (Kollmuss & Agyeman, 2002:245; Schultz, 2001:328; Stern & Dietz, 1994:70-71). If the egoistic orientation is strong the person would perform pro-environmental behaviour, however, should the person have a strong need or desire to obtain an object or engage in a behavioural act which is not pro-environmental, the behaviour will be performed regardless of the environment, as long as the needs and desires of the person are met (Kollmuss & Agyeman, 2002:245).

People also tend to act pro-environmentally based on social-altruistic values. The behaviour is motivated by a belief that other people will be severely impacted by the environmental harm then makes an attempt to protect others from suffering. The third reason for pro-environmental behaviour is concerned with biospheric orientation, which

means they attempt to remove or limit the harm and suffering their behaviour imposes on the non-human world (plants, animals, marine life and birds) (Kollmuss & Agyeman, 2002:245; Schultz, 2001:328; Stern & Dietz, 1994:70-71).

2.3.4.1 Intervening factors

Regardless of the components which provide evidence of why people tend to act pro-environmentally, the following list is of intervening variables influencing performing pro-environmental behaviour:

i **Attitudes and Values**

Attitudes are subject to changes and variations based on the changes in the belief system and values (Fishbein & Ajzen, 1975:218).

ii **Verbal commitments**

Weidenboerner (2008:10-11) explains that what people commit to verbally of what they are willing to do regarding environmental problems correlated with their actual environmental behaviour.

iii **The possibility or opportunity to act pro-environmental**

External infrastructures, resources, economic or financial aid should be available and accessible in order to enable the person to perform the pro-environmental behaviour (Ajzen, 1991:196; Kollmuss & Agyeman, 2002:248).

iv **Incentives**

Internal incentives, such as increased life quality, financial savings and social desirability, reinforce performing pro-environmental behaviour (Kollmuss & Agyeman, 2002:246).

v Reinforcing feedback

The perceived feedback received for performing pro-environmental behaviour can be intrinsic, feeling proud or satisfied that the person did the right thing for the environment, or extrinsic, when the behaviour is approved on a social level such as recycling or removing litter materials (Kollmuss & Agyeman, 2002:246).

vi Economic incentives

Receiving economic incentives, when pro-environmental behaviour or actions are performed, serves as an external motivator to repeat the behaviour or engage in the pro-environmental behaviour. However, economic factors are more effective when intertwined with the availability of supporting infrastructural, psychological and social factors (Kollmuss & Agyeman, 2002:246).

vii Knowledge

Knowledge about the environment and environmental issues is a factor which enables and provokes changes in attitudes and values (Kollmuss & Agyeman, 2002:246). Environmentally related knowledge influences the level of environmental consciousness and results in performing pro-environmental behaviour (Blake, 1999:210).

viii Affect

Breckler (1984:1191) describes affect as the emotional connection and response people experience towards the environment and environmental issues. Sympathy and positive feelings towards the environment play a role in performing pro-environmental behaviour.

ix Verbal expressions or commitment

Weidenboerner (2008:10) support a view that the verbal commitments or statements people express towards the environment play a role in performing behaviour which is consistent.

x Self-efficiency and responsibility

Ajzen and Fishbein (2005:193) argue that it is essential for people to believe they have the ability and necessary skills to perform a specific pro-environmental act. Blake (1999:266) affirms that in the event of a person doubting whether he or she can change, contribute or influence environmental issues, he or she withdraws responsibility for taking the necessary pro-environmental actions.

2.3.5 Measuring environmental attitudes

Attitudes and EA are latent constructs, which mean that they cannot be directly observed (Maio & Haddock, 2015:11; Milfont, 2009:238), therefore, direct measures such as interviews and questionnaires are used, or indirect measures such as observations, response competition and priming are applied to determine attitudes and EA. With regards to measuring EA, Kaiser *et al.* (1999:177) believe that the best approach towards measuring EA is by using an instrument which evaluates the cognitive, affective and behavioural components, as discussed in section 2.3.2. However, the EA or environmental behaviour measurements tend to focus on a single component rather than all three.

Various direct measurement techniques, such as self-reporting and Likert scale measurements, have been developed to assess EA and the extent to which the natural environment is considered as favourable or unfavourable (Alcock, 2012:13). The Ecology scale, Environmental Concern Scale, New Environmental Paradigm Scale and Environmental Attitudes Inventory are popular self-reporting scales utilised in EA-related studies (Milfont, 2009:239). These various scales will be briefly discussed.

2.3.5.1 Ecology scale

Maloney and Ward, (1973:583) were the pioneers in developing the first measuring instrument known as the Ecology Scale (Alcock, 2012:13), consisting of a total of 130 items and measures four sub-scales: (1) Verbal Commitment; (2) Actual Commitment;

(3) Affect; and (4) Knowledge. The statements aim to provide a reflection of different levels of verbal commitment, knowledge about ecological issues, reported behaviour and affect towards ecological problems. Those for the verbal and actual commitment affect sub-scales and are true and false statements which are mixed in the survey. A separate section of the survey is dedicated to the multiple-choice statements of the knowledge sub-scale (Maloney & Ward, 1973:584). In 1975, Maloney *et al.* (1975:787) revised the original and produced a short version which consisted of a total of 45 items.

2.3.5.2 Environmental Concern Scale (ECS)

In 1978 Weigel and Weigel developed the Environmental Concern Scale (ECS) with the aim of evaluating the EA people have towards environmental issues, particularly focusing on pollution and conservation problems (Weigel & Weigel, 1978:5). The limitation of the ESC is that it is based on dominant environmental issues such as energy conservation, degradation of the environmental aesthetic value as well as air and water pollution that were prominent during the period which the scale was developed (Alcock, 2012:14).

2.3.5.3 New Environmental Paradigm (NEP)

Dunlap *et al.* (2000:425) developed the first New Environmental Paradigm (NEP) in 1978, consisting of 12 items which focused on exploring the ecological worldview regarding pollution, population and natural resources. The aim of the NEP was to explore humanity's ability to disturb nature, the existence of limitations related to population growth and the right of humans to dominate nature. The NEP scale was mainly used for environmental research to measure ecological worldviews and pro-environmental behaviour. The main facets were limits to growth, balance of nature and human dominance over the natural environment (anti-anthropocentric) (Dunlap *et al.*, 2000:427,432). Thigpen (1986:224-225) listed the worldviews of the NEP with the following characteristics:

- i Nature must be considered as a valuable entity and not as a resource which is prioritised to achieve economic growth.
- ii Compassion towards various species, people and generations should be shown.
- iii Imposing and causing risk to human health and nature should be avoided.
- iv People should recognise and accept that there are limitations to growth with regards to resource availability and population growth. Due to the limitations of growth it is crucial that humans be willing to adapt and change to the circumstances.
- v Public affairs require openness, co-operation and participation.
- vi The decision-making process should not be based on or determined solely by the inputs and opinions of expert, but instead should be an inclusive process of consultations and participation with various people.

A revised version was published in 2000, as New Ecological Paradigm (NECP) Scale with the aim of addressing the limitations of the first NECP and to improve the scale. It consisted of 15 items which adopted new terminology, provided a balance between pro- and anti-NECP items and delved into a wider range of the ecological worldview. Additional facets were added to a multidimensional revised scale, namely, to determine (1) anti-anthropocentrism; (2) possibility of an eco-crisis; (3) rejection of exemptionalism; (4) fragility of nature's balance; and (5) reality of limits to growth (Dunlap *et al.*, 2000:425-432).

2.3.5.4 Environmental Attitudes Inventory (EAI)

Milfont and Duckitt (2010) developed the Environmental Attitudes Inventory (EAI) with the aim of providing a well-founded psychometrically measure consisting of a multidimensional nature as well the hierarchical structure of EA. The scale was developed with the vision that it should be suitable to be used for cross-cultural EA

studies (Milfont, 2009:239). The scale measured the beliefs and perceptions that people hold towards the natural environment and the quality thereof (Milfont & Duckitt, 2010:82). The complete EAI-scale comprised 120 items with each scale consisting of 10 items. A short-form was developed with 72 items and each scale of six items. A shortened version was developed as a scale to be used for research studies. The shortened EAI-scale had a total of 24 items of which 14 addressed the preservation and 10 utilisation (Milfont & Duckitt, 2010:88). The EA is established by the combination of preservation and utilisation, varying from being unconcerned to concerned about the natural environment (Milfont, 2007:117,188).

The hierarchical structure of the EAI comprises a vertical and horizontal structure, the former seeing preservation and utilisation as two correlated second-order factors. Preservation allude to the beliefs people have towards the importance of protecting and preserving the environment, nature and species from alterations, human use and damage. In contrast to a preservation, utilisation relates to the beliefs people hold to it being appropriate, correct and necessary to alter and use the nature, environment and species to meet the human-centred needs and objectives. The horizontal structure consists of 12 dimensions, with seven first-order factors related to preservation (scales P 1; 2; 3; 6; 8; 11 and 12) and five first-order factors relate to utilisation (scales U 4; 5; 7; 9; and 10). The scale names along with their definitions are provided in Table 2-1 (Milfont & Duckitt, 2010:81,89; Milfont, 2007:188).

**Table 2-1: Dimension of the horizontal structure of EA
(Milfont & Duckitt, 2010:90)**

Horizontal structure of EA		
Scale no.	Scale label	Description of the construct
P 1	Scale 1: Enjoyment of nature	Enjoyment of nature relates to whether people belief that spending time in nature is pleasant and enjoyable. The scale determines whether they prefer to spend their time in nature or within an urban setting.
P 2	Scale 2: Support for interventionist	This scale focuses on whether individuals support or oppose the development and implementation of environmental conservation-related policies and measures.

	conservation policies	The policies and measures regulate and control the utilisation of raw materials and make provision for subsidies as well as supporting renewable energy practices and sources.
P 3	Scale 3: Environmental movement activism	Environmental movement activism refers to willingness to actively participate in and support organisations which aim to protect and preserve that natural environment. In contrast, people might refuse to be involved and associated with environmental conservation organisations.
U 4	Scale 4: Conservation motivated by anthropocentric concern	Environmental protection activities and endorsing environmental conservation policies are motivated by a human-centred interest where the concern for human welfare, survival and gratification are the foundation for the environmental behaviour. In contrast, people protect the environment and support environmental policies from an earth-centred stance because of a genuine concern for the environment and life.
U 5	Scale 5: Confidence in science and technology	People trust and believe that science, human ingenuity and technology will be capable of solving and controlling existing environmental issues and that future environmental harm will be prevented and restored. However, they also believe that science, technology and innovations are not the solution to current or future environmental issues.
P 6	Scale 6: Environmental fragility	The natural environment is viewed as fragile and human activities cause severe environmental damage which could result in irreversible, disastrous consequences. The contrary view is that nature is tough and can withstand the harmful effects of human activities. Harm inflicted upon the environment is considered as reparable and taken up lightly.
U 7	Scale 7: Altering nature	Humans believe that they have the right to dominate nature by changing and altering for the purpose of meeting their goals as opposed to believing that the original state of the environment should be preserved and should not be altered by human activities.
P 8	Scale 8: Personal conservation behaviour	Performing behaviour, activities and practices which conserve and protect natural resources and the environment, contrary to the lack of interest and willingness to change environmental harmful behaviour.
U 9	Scale 9: Human dominance over nature	The following two contrasting viewpoints can be held towards nature: (1) it was created and exists for the sole purpose that people should use, consume and alter it; (2)

		it has the identical rights as humans which means that it should be protected from alterations and harm.
U 10	Scale 10: Human utilisation of nature	The one stance of human utilisation of nature is that it places higher priority on achieving economic growth and development regardless of the environmental harm inflicted. The opposite stance is that protecting the environment should be a greater priority
P 11	Scale 11: Ecocentric concern	Ecocentric concern refers to the emotional experience and concern regarding environmental harm and loss, versus disregarding concerns, feelings or regrets about environmental harm.
P 12	Scale 12: Support for population growth policies	People might support or oppose policies aimed at regulating and controlling population growth and overpopulation.

2.3.6 Summary

A criticism of the ecology scale is that the items focus on specific environmental problems. Although the scale is revised to include relevant and emerging environmental issues, it is preferred to utilise a scale which focusses on general environmental issues. The scale also consists of 130 items which could be time-consuming to complete (McIntyre & Milfont, 2016:99). The ECS was not suitable for this research study, as it is criticised as being an outdated scale which should be revised because the scale focusses on environmental topics that are no longer applicable at this time (Alcock, 2012:14; McIntyre & Milfont, 2016:99).

The NECP scale focusses on the ecological worldviews held by people and measures the degree to which they believe they are part of or superior to nature. It does not focus on environmental issues which make it relevant to any date (McIntyre & Milfont, 2016:99). The focus of this research study was not to determine or assess the participants' ecological worldview, therefore the NECP was not suitable. The development of the EAI-scale integrated various items of existing measurements to develop a sound psychometric measurement which is valid and reliable and addresses the multiple dimensions of EA. Another beneficial characteristic of the EAI-scale is that it has been standardised as appropriate to multi-cultural EA research studies. The EAI-scale has been applied and tested from sample groups in Brazil, New Zealand and

South Africa. The shortened EAI-scale was adopted for this research study as it consisted of 24 statements which allow the participant to complete it in a short period, measuring the beliefs people have towards the natural environment and developed with the aim of being applied to research studies (McIntyre & Milfont, 2016:101; Milfont, 2009:239; Milfont & Duckitt, 2010:82).

2.4 SUSTAINABLE DESIGN

This section focusses on the architectural industry and sustainable designs. The environmental impact associated with architectural projects along with the role of architects will be briefly discussed. A definition of sustainable designs and what it entails will be provided.

2.4.1 Environmental impact of architectural buildings and projects

Architecture can be described as a science and art in which architects can express their creativity while contributing to wider society (McLennan, 2004:226). Erdoğan (2009:1024) confirms that architects contribute in creating the built environment and have a responsibility towards environmental stewardship, sustainable design and planning. Thus, professional architects have a responsibility to explore, plan, consider and implement innovative solutions/remedies to design and construct sustainable architectural projects. Even though architects acknowledge that it is important to address environmental problems in the designs, McLennan (2004:226) states that they should start opening their minds so that it is possible to create an environmentally sustainable building design of a simultaneously a high-quality, captivating and artistic building.

Jong-Jin and Rigdon (1998:7) argues that architecture plays an important role in a country's economic development because it demands that factories, buildings, roads and offices are established and constructed. The construction process adopted to establish buildings and architectural projects requires natural resources, energy, building equipment and land area. As a result, the procurement, construction, fit-out,

operation and demolition process of buildings have an impact on the natural environment which is interconnected on a local and global scale. Halliday (2008:ix) explains that the environmental impact associated with architecture can be categorised as having a direct impact, which relates to the environmental impact of the materials, energy consumption, pollution and waste production as well as an indirect impact which occurs when a structure is inefficient over the lifetime of the building.

2.4.2 Role of architects and architecture

Throughout history, architects have played a role in construction projects as the designers of buildings and creators of construction drawings (Jones, 2006:52). In the past, the main purpose of the architect was to oversee and manage the architectural project from the conception stage through to the completion and operation of the project (Jones, 2006:50). However, over the centuries the scope of work, level of involvement and responsibilities changed (Miller & Burr, 2002:7). Besides the changing role of architects, the construction process also evolved and became more complex. The scale of projects changed, new technologies developed and new techniques were introduced. These factors placed enormous pressure on architects to become more specialised and to involve external specialist knowledge (Jones, 2006:52). Although various specialists are required in the construction process, the architect is considered as the master builder with the main responsibility for producing the concept designs, fulfilling a managerial role and integrating systems (Jones, 2006:23). In Table 2-2 the roles an architect during the construction lifetime of an architectural project are briefly outlined (Thomson, 2017):

**Table 2-2: Architect's roles during the lifetime of architectural projects
(Thomson, 2017)**

Design phase	Roles of the architect
Schematic Design	During the schematic design stage, the architect and the client or owner meet each other. Based on the client's idea, the architect will gain an understanding of the client's needs and the available budget allocated for the project. This knowledge

	will empower the architect to create a design concept for the client's review and approval.
Design Development	Once approval of the concept design is obtained, the concept is further developed into detail which includes general finishes, construction technology and detailed layouts of spaces. Once approval for this design is gained the architect proceeds to the construction document phase.
Construction Documentation	Concept design drawings are further developed into detailed documents accompanying specifications. These documents can be used for tender purposes.
Bidding and Negotiation	During the bidding and negotiation phase the architect will assist the client with the bids and any enquiries from the contractors will be answered by the architect.
Construction Phase	Once the construction of the project commences, the architect will conduct site inspection with the aim to ensure that the project is being constructed as specified in the designs. The architect will also provide information and answers to any enquiries or challenges with which the contractors are confronted and will provide solutions or alternatives for design and construction issues. The material submittals and shop drawings will be approved by the architect.

Soetanto *et al.* (2001:546) believe that the architect, contractor and client are the main role players in architectural projects, crucial and unique during the construction process. The performance of each of these role players are interdependent and will influence the performance, success and progress of the architectural project. The success of an architectural project relies on teams working effectively together while maintaining a good harmonious working relationship (Jones, 2006:51; Soetanto *et al.*, 2001:546). In addition, Lewis (2013:9) notes that the knowledge, skill set and problem-solving ability of an architect are main attributes that are crucial to the success of an architectural project. Besides these attributes, the ability of an architect to design an aesthetic functional building, structure and built environment is a key role. If an architectural building or project is poorly designed, it will produce an unhealthy environment which negatively influences individuals, reduces human performance and causes health issues. In contrast, sustainable building designs have the opposite effect as they enhance learning and productivity, and improve communities and human wellbeing. Therefore, it is essential that sustainable buildings are designed and

constructed which are beneficial to the environment, people and community (Halliday, 2008:ix; McClure & Bartuska, 2007:ix).

Ding (2008:451) and Lee (2012:77) wrote that in order to have a successfully functional sustainable building which has a minimal environmental impact, sustainable design methods should be incorporated during the design stage of an architectural project. Therefore, the architect should approach the design process with the goal of creating a sustainable design that is creative, environmentally sustainable and adheres to the current political, environmental and economical requirements (Erdoğan, 2009:1024).

2.4.3 Defining sustainable design

“Green architecture”, “green building” and “sustainable architecture” are synonyms in the field of sustainable designs in architecture (Ragheb *et al.*, 2016:778). Regardless of the term used, for Lewis (2013:3) and Ragheb *et al.* (2016:778) the essence of architecture is to rise to the challenge of designing and creating a physical structure and environment that is aesthetic, functions successfully and incorporates environmental sustainable principles. Buildings should be visual artistic expressions that are realistic to build and simultaneously accommodate human functions, be resilient to the natural elements, use energy and natural resources efficiently, and be financially viable to construct and operate. The present challenge architects confronting architecture is to ensure that environmentally sustainable buildings are designed and constructed which are beneficial to present and future human society and the natural environment (Halliday, 2008:1; Lee, 2012:79).

Halliday (2008:ix) emphasises that a building is considered sustainable when the throughput of resources utilised are minimised, minimum waste and pollution are produced, a community is created, supported and enhanced, the environment and biodiversity species are protected and enhanced, and processes are effectively managed. Loftness *et al.* (2007:965) argue that additional requirements of sustainable buildings are functionality, durability and safety for the occupants. In addition, the Green Building Council of South Africa (GBCSA, 2017) defines a sustainable building as one which is resource-efficient and has a low energy demand. To create a

sustainable building, the architectural design, construction and operation practices adopted should focus on minimising negative environmental consequences and aim to create a healthy, productive environment for the occupants.

Regardless of the numerous definitions regarding sustainable buildings, they all rely on an appropriate design. McLennan (2004:4) regards sustainable design as a growing and evolving movement in which the way buildings are designed, built and operated is redefined and changed to be more environmentally responsible. Sustainable design is defined as a philosophy and collective process which guides the design process towards maximising the quality of the built environment and simultaneously sees any impact on the natural environment being reduced or ultimately eliminated (Loftness *et al.*, 2007:965; McLennan, 2004:4). The outcome of the sustainable design process should thus result in a sustainable building which is ecologically balanced, humane and viable over its life-cycle and inputs. Sustainable designs optimise utilisation and integration of natural elements, for example, day lighting, solar heating and natural ventilation, and technologies to provide human comfort and limit exhaustion of natural resources (Loftness *et al.*, 2007:965).

2.4.4 Sustainable design principles

The principles which provide architects with guidance regarding how to create sustainable designs will be discussed in this section.

2.4.4.1 Six governing principles

McLennan (2004:3-7) provides the following six governing principles for sustainable design which is based on respect. He argues that when something is respected it is honoured and there is sense of stewardship and protection involved. The opposite of respect is contempt, which entails neglecting, abusing and over-utilising something.

i Respect for the wisdom of natural systems – Biomimicry principle

Biomimicry refers to architectural designs and technologies inspired by nature. Nature and the way natural elements function can provide designers with knowledge which can be used to develop products and technologies that enhance sustainable buildings. In the design stage, an understanding must be gained about how natural principles can be utilised, such as daylighting, passive solar heating and natural ventilation. The way that the built environment and buildings are designed should copy natural systems (McLennan, 2004:39-44).

ii Respect for people – the human vitality principle

The foundation of the respect for people principle focuses on taking the unique needs of the people into consideration. A healthy building environment is created in which people are comfortable, and the building promotes human wellbeing (McLennan, 2004:46-49).

iii Respect for place – Ecosystem principle

This principle refers to respecting the cultural importance, heritage, land value, geographical aspects and natural significance of a site. Therefore, some places are valued as being ill-suited for development or transformation. The attitude towards modern development is that no place is too significant or exceptional, therefore, the natural environment is changed for developmental purposes. This principle is that the development should be appropriate to the carry-capacity of the region (McLennan, 2004:52-62).

iv Respect for the cycle of life – the seven generations principle

Mankind is part of a greater cycle that is interconnected and interdependent. The role humans play and everything they create can impact and cause disruption in the balance of this cycle. Therefore, the life expectancy of products that humans invent should suit the timeframe for which they are used. Products are made to last for long timespans even if only intended for a short period. With regards to architecture, the cycle of life principle is about ensuring that a safe building is constructed which will last for centuries (McLennan, 2004:64-72).

v Respect for energy and natural resources – conservation principle

This principle has a dual focus on conservation. Firstly, it values energy as a precious product which should be used wisely and responsibly. Necessary steps should be adopted and implemented to save energy. The second component is that natural resources should be preserved by utilising and developing technologies that require limited natural resource input (McLennan, 2004:73-84).

vi Respect for process – the holistic thinking process

Building designs and the construction thereof is based on familiar knowledge and experience of the architect. However, the built environment is changing and advocating sustainable designs which require a new way of thinking and a changing approach towards them. The incorporation of sustainable designs are continuously growing and changing, and what was once taught in the field of architecture becomes outdated. Therefore, it is crucial to continuously gain new knowledge and to question, re-evaluate and reconsider decisions, standard processes and assumptions which were automatically made in the past, due to familiarity. Only then will change occur from unsustainable to sustainable designs. A holistic approach towards designs requires collaborating with various related disciplines and incorporating the input and knowledge into them (McLennan, 2004:86-92).

Respecting the process of sustainable designs requires respect for time. Adequate amount of time should be allowed for wise decision-making, thorough planning, developing a sound sustainable design and considering sustainable solutions which limit the environmental impact (McLennan, 2004:93-94).

2.4.4.2 Three principles of sustainable design

Jong-Jin and Rigdon (1998:1-28) proposes that economy of resources, life-cycle design and humane design as three principles that guide sustainable design in architecture. Each consists of various unique strategies and methods which are summarised in Table 2-3.

i Economy of resources

Economy of resources requires that the amount of non-renewable resources utilised during the life-cycle of a building is limited. The principles of reduce, re-use and recycling of natural resources are adopted to conserve natural resources (Jong-Jin & Rigdon, 1998:9).

The law of resource flow conservation applies to this principle: this entails that the non-renewable resources input or upstream resources required should be reduced. In addition, the output flow of the building should make a minimum contribution to environmental pollution. Energy conservation, water conservation and material conservation are the strategies embedded in the economy of resources principles (Jong-Jin & Rigdon, 1998:9,16).

ii Life-cycle design

Life-cycle design refers to analysis of the building's processes and environmental impact. It can be approached using two models: (1) the conventional linear process, or (2) the cradle-to-grave concept. The linear process comprises the various phases of a building: design, construction, operation and maintenance, as well as demolition. This process neglects to incorporate environmental issues and waste management. In contrast to the linear process, the cradle-to-grave concept incorporates the entire environmental impact with regards to the life-cycle of the resources required, procurement process and return-to-nature of products after demolition. The strategies associated with life-cycle design entail adopting sustainable design methods during the pre-building, building and post-building phase (Jong-Jin & Rigdon, 1998:8,11).

iii Humane design

Humane design revolves around the interaction and coexistence between the natural environment and humans. Humane design refers to the stewardship and altruistic goal to preserve the environment and ecosystems for the sake of human survival. The preservation of natural conditions, urban design and site planning as well as design for human comfort strategies aim to ensure that the quality of

life for human-beings and species are improved (Jong-Jin & Rigdon, 1998:14-15).

Table 2-3: Sustainable design principles, strategies and methods (Jong-Jin & Rigdon, 1998:16-28)

Principle	Strategy	Method
Economy of resource	Energy conservation: The energy conservation strategy focusses on the energy demand required once a building is operational.	Energy-conscious site planning: Availability of public transportation services is taken into consideration. Existing buildings are re-developed, re-used or enhanced instead of a new one being constructed. Climatic conditions are taken into consideration in the design (e.g., orientation and natural ventilation).
		Passive heating and cooling: Passive solar radiation is utilised for natural heating, cooling and lighting.
		Alternative energy sources: Renewable energy technologies and systems are implemented to reduce demand on external energy sources and conventional energy.

		<p>Insulation: Materials with high insulation properties are implemented to reduce the exposure of external noise and to reduce heat gain and loss.</p>
		<p>Daylighting: The design of the building optimises the utilisation of natural light to reduce the demand on electricity.</p>
		<p>Utilise low embodied-energy materials: Utilise construction materials which require fewer resources to produce and have to be transported shorter distances (e.g., locally available materials procured rather than internationally available ones being imported). The life-cycles of materials are considered as some are energy-consuming in mining and production. Considering utilising low embodied-energy materials reduces the environmental impact of the architectural project.</p>
		<p>Utilise energy efficient appliances: The operational cost of the building is considered as efficient energy appliances and technologies contribute to future savings.</p>
	<p>Water conservation: The operation of a building is water-intensive. It is therefore important to implement various methods to minimise the quantity of water required. The waste water leaving the site is also taken into consideration.</p>	<p>Re-use water on-site: Greywater and sewage water recycling practices reduce the potable water demand. Rainwater harvesting is a valuable source for reusing water on site.</p> <p>Reduce water consumption: Utilise water supply systems and low water demand fixtures to reduce water usage and waste. Indigenous landscaping should be utilised to reduce water consumption, and water conservative irrigation systems should be implemented.</p>

	Material conservation: Thorough planning is required regarding the production, utilisation and consumption of construction materials to minimise the quantity of construction waste produced. The life-cycle of the materials has an environmental impact which should be taken into consideration.	Refurbish and repurpose existing buildings: Converting and refurbishing existing buildings to serve a new purpose is more cost-effective than constructing a new building.
		Incorporate recycled materials: The construction materials of demolished buildings could be utilised for the construction of other buildings.
		Consider the scale and size of the building.: The size of a building should be adequate for its purpose and number of occupants. The design should be based on the standardised size of building materials to reduce waste generation.
		Re-use non-conventional products as construction materials: Utilising construction materials made from recycled materials or products reduces the quantity of materials disposed at landfill sites.
		Consumer goods. Once consumer goods are no longer useful the product ends up as waste. Buildings can make provision for on-site recycling facilities or sorting bins. As a result, the products are re-used and recycled where possible instead of being disposed at landfill sites.

Life-cycle design	Pre-building phase: The environmental impact of the materials utilised for the building is considered in the building design.	Utilise materials made from renewable resources: Reducing the demand of non-renewable materials such as metal and petroleum requires that building depend more on renewable materials such as glass, wood and bamboo.
		Utilise materials which are harvested and extracted without causing ecological harm: The methods used to extract raw materials cause ecological harm. Therefore, architects should be familiar with the manufacturing and supply processes.
		Utilise recycled materials: Utilising and incorporating recycled materials for the construction of a building minimising the demand on mining and milling.
		Utilise durable and low maintenance materials: Utilising durable materials results in less maintenance and fewer replacements.
	Building phase: The environmental impact of the construction and operation process should be taken into consideration.	Minimise the site impact: During the construction phase of a building the movement of machinery, excavation and construction activities can cause environmental harm and alterations to the site and surrounding environment. The aim is to limit and control the environmental impact by respecting the existing topography, fauna and flora and natural characteristics.
		Utilise non-toxic materials: It is important to consider the health and wellbeing of the end-user during the construction phase by utilising materials which are not-toxic.

	Post-building phase: The environmental impact of an existing building is assessed once the structure is no longer useful. The architect considers reusing, recycling or demolishing of the building.	Re-use buildings: Reusing building for a new or other purpose to reduce the environmental impact of construction of a new building. If a building is no longer being used and cannot be re-used it is advisable to re-use the building materials (e.g., doors, windows, interior fixtures and bricks).
		Recycle materials: Materials from existing buildings are recycled to be used elsewhere.
		Re-use existing buildings and infrastructure: Consider utilising abandoned structures and existing infrastructures instead of establishing a new building or development in a vacant, undisturbed area.
Humane design	Preservation of natural conditions: The architect should aim to preserve the natural characteristics and elements which exist at the building location.	Consider and incorporate the site topography: Incorporate the existing topography and contours in the building design instead of causing unnecessary alteration. In order to understand the landscape conditions a thorough site analysis is required.
		Avoid disturbing the water table: The building design should avoid excavation below the water table. The aim is to avoid disturbance to the natural hydrology.
		Preserve existing fauna and flora: The existing vegetation, wildlife and habitats should be incorporated into the design. During the construction process the necessary measures should be taken to protect the existing fauna and flora. Once the construction is complete the nature should be rehabilitated.

	Urban design and site planning: Integrating urban design methods and site planning is applicable for larger architectural projects and not specifically apply to individual buildings/houses.	Integrate existing urban fabric: The design of the building or architectural project should enable and encourage people to use existing public transportation systems. The architectural project should respect and fit into the existing urban life, layout and patterns.
		Promote mixed use development: Designing developments which make provision for residential, commercial, offices and retail services, provide people with the opportunity to live near their work and commute less.
	Design for Human comfort: The architectural design should incorporate elements which allow people to adjust to the indoor environment to ensure human comfort. The design should also ensure that the building is user-friendly and functional to occupy.	Provide thermal, visual and acoustic comfort: Creating a space which is air tight and consists of adequate lighting, ventilation and noise cancelation, optimises human experience, comfort and productivity.
		Provide visual connection to the exterior environment: The design of a building should enable a person to observe daytime and weather conditions. Skylights and windows allow people to observe solar movement and time passing.
		Provide operable windows: Making provision for manually operable windows allows the end-user to control the indoor temperature and ventilation.
		Make provisions for fresh air inlet: Fresh air supply is critical for human functioning, health and wellbeing.
		Use non-toxic and non-outgassing materials: Chemicals and materials which is non-toxic should be used to promote human health.

		Accommodate physical abilities: The design of buildings should be adaptable to accommodate various age groups and physical conditions.
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2.4.4.3 Green building South Africa sustainable design principles

The Department of Environmental Affairs and Tourism (DEAT, 2010:66-67) outlines environmental, economic and social sustainability as the main objectives of sustainable design and construction. Each objective along with the various associated strategies set to achieve the objective will be briefly discussed (refer to Table 2-4).

i Environmental Sustainability

The focus of environmental sustainability is to minimise the utilisation of energy, water and resources. It encompasses the principles of reduce, re-use and recycle. The strategies associated with environmental sustainability entail considering site characteristics, water management, landscaping factors (drip irrigation, indigenous plants and creating habitats), energy and atmosphere efficiency, material selection and efficient waste management (refer to Table 2-4) (DEAT, 2010:66-67).

ii Economic Sustainability

Economic sustainability encourages the involvement of local labourers and supporting small businesses to provide materials or services. It also focusses on the life-cycle of a structure or building. The various embedded strategies entail local economic development, efficiency of use, adaptability and flexibility (refer to Table 2-4) (DEAT, 2010:67).

iii Social Sustainability

Social sustainability focusses on the needs of the end-user and taking the input of the end-user into consideration when designing. The foundation is to create an environment which is healthy, comfortable and safe to the people. The social sustainability strategy entails user comfort, creating a healthy indoor

environment, ensuring safety and promoting education (refer to Table 2-4) (DEAT, 2010:67).

Table 2-4: DEAT sustainable design objectives and strategies
(DEAT, 2010:66-69)

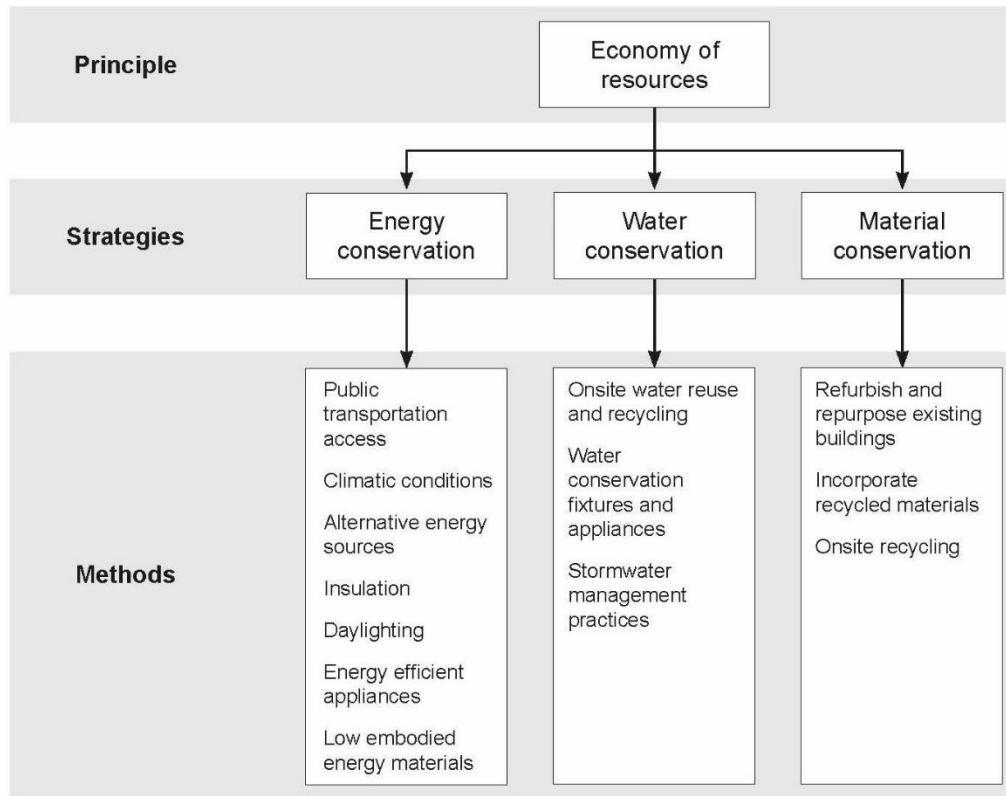
Sustainable design objective	Strategy
Environmental sustainability	<p>Site characteristics:</p> <p>The existing natural environment, fauna, flora and habitats should be protected and enhanced.</p> <p>The footprint of the building should be minimised.</p> <p>Indigenous vegetation should be established at the building site.</p> <p>Existing contaminated soil should be rehabilitated before construction of a building commences.</p>
	<p>Water management:</p> <p>The aim is to reduce the demand of potable water required, therefore, it is advised to utilise water efficient systems and devices.</p> <p>Water meters should be installed to monitor consumption and waste.</p> <p>Implementing rainwater harvesting practices is ideal for irrigation purposes and toilet flushing.</p> <p>Considering greywater recycling practices reduces the demand of portable water supply.</p> <p>Storm water management practices focus on allowing water to infiltrate into the natural environment. Storm water can also be collected to be re-used on-site.</p>

	<p>Landscaping: Low water demand plants and water-saving irrigation systems should be selected to enhance habitats and reduce water demand.</p>
	<p>Energy and atmosphere: The building design should make provision for day lighting, passive heating, cooling and ventilation. Implement energy efficient and saving appliances. Implement renewable energy systems to reduce the demand on conventional energy sources. Avoid utilising and implementing ozone-depleting substances. Encourage utilisation of bicycles as a means of transportation. Conduct energy modelling studies during the construction process to predict the estimated energy demand.</p>
	<p>Material selection: Consider reusing existing structures and where possible use sustainable materials.</p>
	<p>Waste management: Adopt a waste management plan during the construction phase to enable recycling and reusing of materials.</p>
Social sustainability	<p>User comfort: Make provision for daylighting, fresh air supply and glare control.</p>
	<p>Healthy indoor environment: During the material selection process, the toxicity level should be considered to ensure that the indoor environment is safe for the occupants.</p>
	<p>Safety: Adhere to the necessary safety regulations during the construction phase of a building. Incorporate measure which make provision for disabilities. Consider availability and easy access to public transportation services into the design. Make provision for mixed services, such as retail, recreation and banking near the building or architectural project. Ensure that the end-user can control the indoor environment.</p>

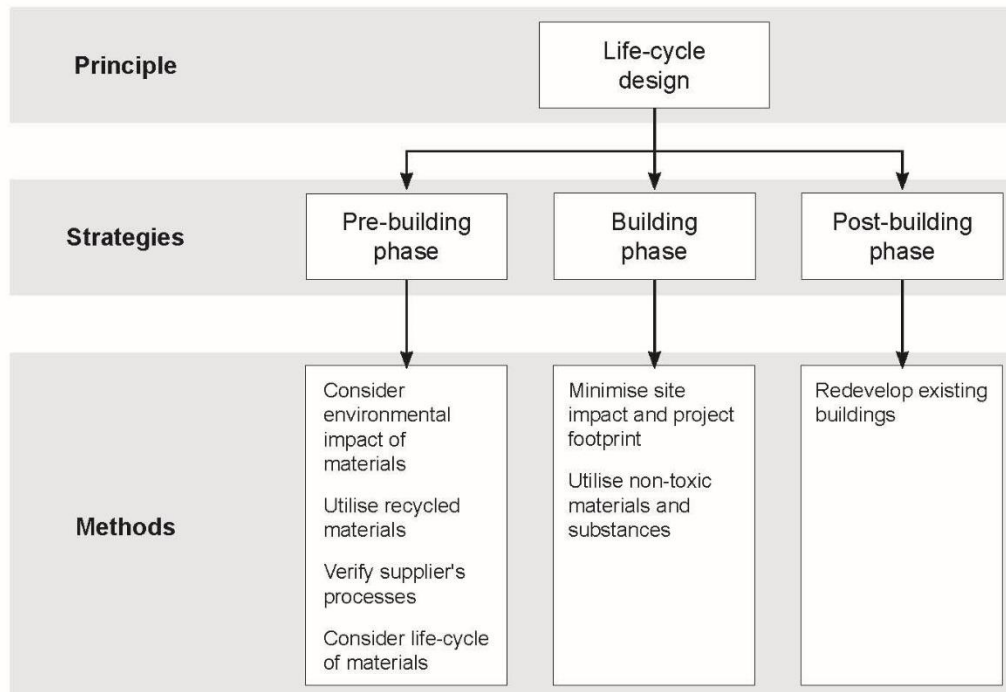
	<p>Education:</p> <p>During the construction phase, necessary training should be provided to the staff members and adequate management should oversee the construction.</p> <p>Ensuring that the sustainable measures, technology and systems are visible and contribute to educating the end-user.</p>
Economic sustainability	<p>Local economic development:</p> <p>Utilise the local workforce as a means of job creation.</p> <p>Support locally produced materials and components available.</p> <p>Support local, start-up and small manufacturers, suppliers and contractors.</p>
	<p>Efficiency of use:</p> <p>Avoid and minimise the existence of non-usable space in a building.</p>
	<p>Adaptability and flexibility:</p> <p>Design a building or architectural project with the option that it can be used for other purposes.</p> <p>Consider designing the fixed structures in way which will allow for easy future renovation.</p>
	<p>On-going cost:</p> <p>Consider the operational cost of materials, systems, equipment and facilities incorporated into the building design.</p> <p>Implementing meters enable people to monitor the energy and water consumption. Displaying or informing the occupants of the consumption behaviour, encourages caution and conservation behaviour.</p>

2.4.4.4 Adopted sustainable design principles, strategies and methods

Based on the abovementioned discussion (refer to sections 2.4.4.2 and 2.4.4.3), it can be concluded that the sustainable objectives of the DEAT are coherent with three sustainable design principles discussed in section 2.4.4.2. Therefore, for this research study the following design principles and strategies will serve as a guideline for the research as illustrated in Figure 2-6, Figure 2-7 and Figure 2-8 (Jong-Jin & Rigdon, 1998:1-28).



**Figure 2-6: Economy of resources strategies and methods
(Jong-Jin & Rigdon, 1998:17)**



**Figure 2-7: Life-cycle design strategies and methods
(Jong-Jin & Rigdon, 1998:23)**

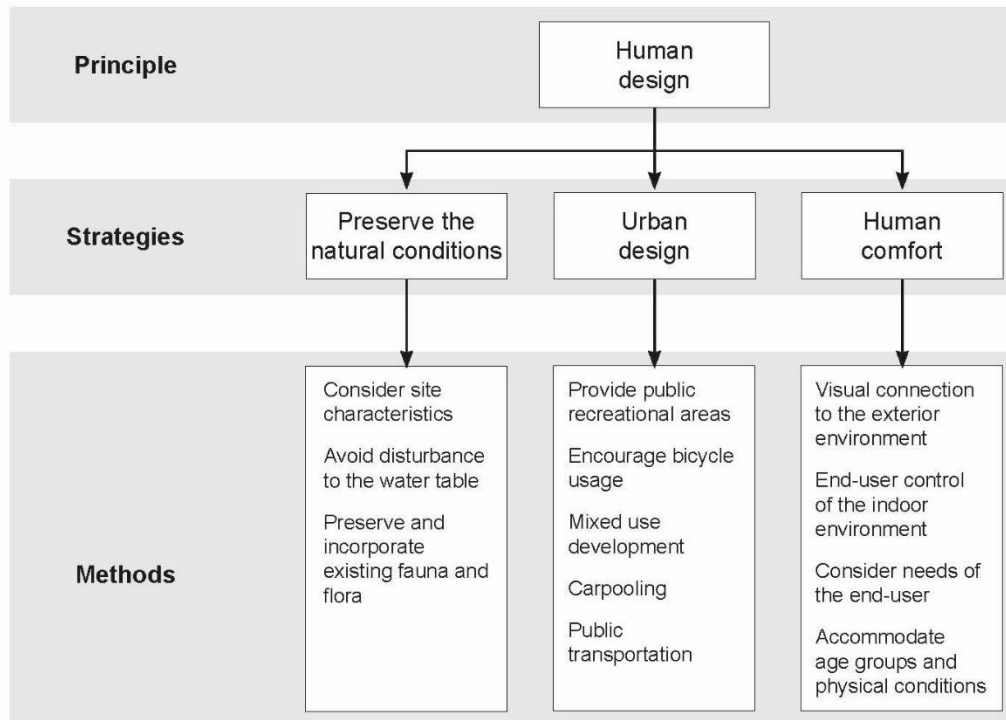


Figure 2-8: Humane design strategies and methods
(Jong-Jin & Rigdon, 1998:26)

2.5 SUMMARY

This chapter has provided an overview of the existing literature relevant to this research study. A definition of EA was formulated along with the purpose it serves and the structure. Various attitude-behaviour relation theories were explored as well as the various intervening factors which inhibit an individual from performing pro-environmental behaviour related to their EA.

A brief overview was provided about the popular direct measuring instruments available to assess EA. The follow-up section focused on sustainable designs, the impact of architectural projects on the environment and what role architects fulfil. A definition of sustainable designs was devised and the guiding principles for sustainable designs were explored.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 INTRODUCTION

Chapter 2 presented a literature review regarding EA and sustainable design methods in the architectural industry. This chapter elaborates on the methodology adopted for this research study along with how it was practically implemented. The research paradigm will be discussed, followed by research approach adopted. The advantages and drawbacks regarding surveys will be explored along with the implementation process. The chapter will be concluded by a discussion regarding data collection and data analysis techniques utilised.

3.2 RESEARCH PARADIGMS

A research paradigm refers to the philosophical orientation which embeds the assumptions, propositions or beliefs the researchers hold towards the nature of research and the world (Creswell, 2014:35; Sarantakos, 2013:29). The philosophical orientation has a pivotal role in how the research is conducted because it provides an explanation why a specific research approach (quantitative or qualitative) is adopted (Creswell, 2014:35).

According to Sarantakos (2013:29), there is various research paradigms that exist which each consist of ontology and epistemology, as well as two belief systems (axiology and methodology). Ontology is about how reality is perceived and it embeds realism, materialism and idealism (Sarantakos, 2013:28; Snape & Spencer, 2003:11). In contrast, epistemology refers to the means utilised to obtain knowledge along with validating that the information is reliable and true (Sarantakos, 2013:28; Wahyuni, 2012:69). The methodology belief systems refer to the research strategy (qualitative or quantitative) adopted to perform the research within the context of a specific paradigm (Sarantakos, 2013:28). Axiology is concerned with ethics and the part that values have

in research as well what the position the researcher holds towards the research topic (Wahyuni, 2012:69).

The following section will provide a brief description of the research paradigm applicable to this research study.

3.2.1 Positivistic research paradigm

The positivistic research paradigm assumes that the world is structured, ordered, regular and independent and that it conforms to casual laws. Therefore, the objective is to discover and explore these laws and patterns. The other assumption is that reality, the world and knowledge can be objectively explored through sense experiences. The knowledge gained should be factual, accurate, precise and objective. The role of the researcher is to maintain an unbiased position, with the research not influenced by his or her values or beliefs (Sarantakos, 2012:34; Snape & Spencer, 2003:16). Researchers utilising a positivistic research approach collect quantitative data through experiments, statistics and surveys to expand the predictive understanding of the research phenomena (Neuman, 2014:97). The quantitative data can be statistically analysed and generalised to a larger population (Mack, 2010:6; Shah & Al-Bargi, 2013:254). The quantitative research approach along with the data collection techniques prevents the researcher from influencing the respondents and provides objective, logical results. He or she investigates the research topic in a rational and objective way with personal feelings not interfering (Oates, 2006:284-286).

3.2.2 Implementation of a positivistic research paradigm

The focus of positivistic research is to explain relationships, identify patterns and test a hypothesis (Dash, 2005; Oates, 2006:986). Since the aim of this research study is to explore and explain the relationship between EA and consider sustainable design methods in architectural projects, a positivistic research paradigm is applicable.

3.3 RESEARCH APPROACH

Neuman (2014:167) defines a research approach as the systematic process and procedures followed to collect data, which can be examined and interpreted to create an understanding and explanation of the research topic or phenomena. Qualitative and quantitative research are the two main research approaches that will be discussed in this section.

3.3.1 Qualitative research approach

A qualitative research approach is applied to explore a specific social and cultural phenomenon (Myers, 1997:2). The researcher aims to collect in-depth descriptive data to gain a clear understanding and interpretation of the research topic. Qualitative research focusses on how the participants view and understand the world and how they construct meaning from their experiences (Nieuwenhuis, 2007a:50). Qualitative research designs may include conceptual studies, historical research, action research, case study research, ethnography and grounded theory (Nieuwenhuis, 2007b:70). According to Szyjka (2012:111), qualitative research assumes that reality is socially constructed and the variables are interconnected and complex to measure. The researcher adopts a qualitative research approach due to personal experience and interest in the research topic. The subjective position of the qualitative researcher is recognised as part of the research process and the researcher is personally involved in the data collection process (Szyjka, 2012:111-112).

In qualitative research, an interactive relationship exists between the researcher and participants, who are observed or interviewed to gain an understanding and to construct meaning about the research topic. The participants disclose their personal experiences, narratives, beliefs and perspectives related to a specific context. The qualitative researcher acknowledges that the information collected is biased and subjective but it is taken as the truth as other interest groups within the same context might share similar experiences, beliefs, narratives and perspectives. The researcher does not manipulate the data nor generalise it to a larger or other population group (Nieuwenhuis, 2007a:55; Nieuwenhuis, 2007b:79; Szyjka, 2012:112).

3.3.2 Quantitative research approach

Quantitative research emerged from the natural sciences to explore and explain a phenomenon through numerical data (Myers, 1997:2). Mathematically based methods are applied to analyse the collected data (Sukamolson, 2007:2) and the information gathered is broadly generalised across a larger population group (Szyjka, 2012:113). According to De Vos *et al.* (2011:144), quantitative research can be categorised into two main research designs, namely, experimental and non-experimental. The former is adopted for cause-and-effect research studies where a comparison between the control group and experimental group is being explored. The differences in the outcome between the two groups are studied. Experimental studies contain some manipulation and control as some participants receive certain treatment or intervention and the other group receive different or no treatment or intervention (Maree & Pietersen, 2007a:149).

Contrary to experimental design, non-experimental designs are mainly adopted for descriptive studies in which the specific units are measured on all the variables during a period (Maree & Pietersen, 2007a:152). The researcher aims to establish and indicate the association that exists between variables. During non-experimental research studies, no control group is involved in the research and no manipulation of the data, variables or participants take place. Survey research methods are commonly utilised for non-experimental studies as they allow the researcher to describe and explore the quantitative data collected (Maree & Pietersen, 2007a:152).

3.3.3 Implementation of a quantitative research approach

A quantitative research approach was used to collect the data of this research study as it could be easily quantified and statistical analysis performed (Patten, 2016:9). According to Sukamolson (2007:9), that quantitative research approaches are applied in research studies when the researcher wishes to quantify opinions, attitudes or behaviour in order to establish how a larger population group feels about the research topic. A benefit is that the researcher plays an objective role and it is not possible to

influence the research findings (Szyjka, 2012:113). In addition, Sukamolson (2007:11) highlights the following benefits of adopting a qualitative research approach:

- i It provides estimates of the population at large.
- ii Statistical comparisons can be determined between various groups.
- iii The level of actions and occurrences can be measured and determined.
- iv The extensiveness of attitudes people hold can be determined.
- v The results collected can be translated into statistical data.
- vi The data gained is standardised, accurate, specific and precise.
- vii It enables the researcher to provide information related to quantity (e.g., how many...) and re-occurrences (e.g., how often...).

3.4 RESEARCH METHOD

Bryman (2016:40) and Creswell (2003:5) describe a research method as the specific technique or procedure adopted to collect the data, including the instruments that were used to collect and analyse it. Surveys or polls are the most popular research method adopted in quantitative research studies (Sukamolson, 2007:4), the former generally utilised to study and determine the attitude, behaviour or beliefs of participants through observations, interviews or questions (Patten, 2016:9). The following sections will describe surveys and web-based surveys as a research method along with the associated advantages and disadvantages.

3.4.1 Surveys

According to Sukamolson (2007:4), surveys are one of the various types of quantitative research that exist. They make up a systematic process which entails using scientific sampling techniques and designing of a questionnaire to gain information that enables

the researcher to measure certain characteristics of a specific population group with statistical precision. Surveys measure variables and from the collected data several hypotheses can be tested, specific comparisons drawn, and predictions made (Maree & Pietersen, 2007b:155; Sukamolson, 2007:4). Surveys are generally used when variables are obtained from a large population group within a specific time. The quantitative data is analysed to determine patterns and associations which are generalised to a larger population group (Bryman, 2016:54; Oates 2006:93).

Conventional survey techniques may be postal surveys, telephone surveys, in-person or face-to-face surveys and group administered questionnaires (Maree & Pietersen, 2007b:157-158). However, Couper (2000:464) predicted that the use of online or Internet surveys would replace the traditional survey techniques as e-mail and web surveys emerged as alternate options. Jansen *et al.* (2007:2) define electronic surveys (e-surveys) as a process in which a computer plays the main role in delivering and collecting the data. Based on the type of technology used, e-surveys can be categorised into three types: (1) point-of-contact, (2) e-mail based, or (3) web-based. A point-of-contact survey requires that respondents complete the survey on a computer provided by the researcher in an on-site or laboratory setting. As the names suggest, e-mail based surveys are delivered to the participants through e-mail, while web-based surveys are placed on a network server which the participant accesses through a web-browser.

3.4.1.1 Advantages of surveys

Oates (2006:104) highlights the following advantages regarding surveys:

- i The data collected can be generalised to represent a larger population group.
- ii A large sum of data can be collected within a short time in a cost-effective manner.
- iii Quantitative conclusions can be drawn which are numerically represented and so might appear more attractive to readers.

- iv The quantitative research method adopted can be replicated and repeated in other research studies to collect the same data.
- v A researcher struggling to communicate with people can easily use surveys as they do not have to interact with the participants.
- vi According to Neuman (2014:347), surveys eliminate bias as the researcher does not influence the responses or answers of the participants.

3.4.1.2 Disadvantages of surveys

The disadvantages of surveys are:

- i They provide a broad spectrum of data and no in-depth is collected to create a clear understanding of the research phenomena (Oates, 2006:105).
- ii They restrict participants' ability to ask for clarification regarding questions. The content of the survey guides the responses, therefore, the responses are subject to the respondents' interpretations and understanding of the questions (Simon & Goes, 2013:2).
- iii Survey research focusses on quantitative data and not all research topics are suitable for quantitative analysis and are therefore ignored (Oates, 2006:105).
- iv Surveys are utilised during a specific period, therefore continuous changes and processes cannot be evaluated (Oates, 2006:105).
- v There is potential for researcher bias as analysis of the data can be influenced (Simon & Goes, 2013:2).
- vi The data can illustrate associations which exist, but it is not possible to determine cause-and-effect (Oates, 2006:105).
- vii The body language of participants cannot be evaluated in order to establish accuracy and honesty (Oates, 2006:105).

3.4.1.3 Advantages of web-based surveys

Jansen *et al.* (2007:4) and Fleming and Bowden (2009:285) highlight the following advantages of web-based surveys:

- i The delivery and return are a quick and easy process.
- ii The survey can reach a large group of participants.
- iii It is a cost-effective method.
- iv Multiple format designs can be used in the survey, for example, multiple choice, Likert scale and descriptive questions.
- v The collected data remains confidential.
- vi The collected data can be captured and extracted directly from the database.
- vii Compiling the web-based survey is an easy process.
- viii The researcher has immediate access to the results and can track the number of surveys completed.
- ix The responses from the survey are automatically stored and inserted into a spreadsheet or statistical package, which makes the statistical analysis process easier. As a result, human error is limited as the data does not have to be manually captured.
- x The participant can complete the survey at their leisure and at their own pace, without any geographical limitations.

3.4.1.4 Disadvantages of web-based surveys

Jansen *et al.* (2007:4) highlight the following disadvantages of web-based surveys:

- i Technical difficulties and incompatible software can cause a decrease in return rates.

- ii The population group is limited because only participants who have access to the Internet and electronic devices can receive and participate in the research study.
- iii Poor security can threaten the validity of the study.
- iv Once the survey is sent out and data being collected can be adjusted and changed, based on the feedback. As a result, the validity and reliability are compromised.

3.4.2 Implementation of a surveys

This research study utilised a web-based survey to collect quantitative data from a large group of South African architects that can be used to describe and explore this research topic. An e-mail with a covering letter attached was sent to the architects (refer to annexure A). The link of the web-based survey was included in the covering letter as well as the e-mail to provide the participants with easy access to the web-based survey. Once the survey was completed and submitted the data was immediately stored online for later analysis (Jansen *et al.*, 2007:3).

According to Oates (2006:94), the planning and conducting process of surveys consists of the following six activities: (1) data requirements; (2) data generation method; (3) sampling frame; (4) sampling techniques; (5) sample size; and (6) response rate and non-responses. These six activities will be discussed in the following sections.

3.4.2.1 Data requirement

Data requirement refers to the data that should be collected from the questionnaire to answer the research question. This process requires thorough planning and consideration as the researcher only has one opportunity to obtain the information (Oates, 2006:94). In order to determine the EA of architects, the shortened Environmental Attitudes Inventory scale (EAI-scale) development by Milfont and Duckitt (2010:80-94) was used (as discussed in section 2.3.6). Based on the literature

from Jong-Jin & Rigdon (1998:1-28), questions were formulated regarding sustainable architecture designs (as discussed in section 2.4.4.4).

3.4.2.2 Data generation method

Data generation method refers to the type of method adopted to gather the data (Oates, 2006:94). A web-based survey was adopted for this research study which the participants could easily complete at their convenience. In addition, this was a cost-effective method to implement in order to obtain the necessary data (Fleming & Bowden, 2009:285).

The questionnaire was made electronically available to the participants through *Google Forms* which they completed online, a benefit being that the responses remained anonymous and were immediately stored and available to the researcher. In addition, the data could be easily downloaded into an *MS Excel* spreadsheet for statistical analysis.

3.4.2.3 Sampling frame and sampling technique

The sampling frame alludes to a list or database which consists of the population group which can be included to participate in the research study (Oates, 2006:95). According to Maree and Pietersen (2007c:172), time and cost restraints limit the researcher to reach out to a large population group. Therefore, it is critical that the sample of participants should be valid and the results generalisable to the larger population (Maree & Pietersen, 2007c:172).

As it was not possible to obtain a list of all the active practicing professional architects registered at the South African Council for the Architectural Profession (SACAP), a convenience sampling technique was applied. A convenience sample is a non-probability sampling technique in which the participants included in the study are based on the criteria that they were easily accessible and conveniently available. The benefits of applying convenience sampling are that it is cost effective and a quick process,

though it has been criticised as being flawed as it is difficult to control and measure the variability and bias of the population group (Acharya *et al.*, 2013:332; Maree & Pietersen, 2007c:177). The target population group criteria were determined by the information gained from the Architectural Profession Act (44 of 2000) and the requirements set out by the SACAP regarding the roles and responsibilities of South African architects.

Section 18(1) of the Architectural Profession Act (44 of 2000) states that an architect can be registered as a professional or candidate architect. There are four major registration categories for professional architects as well as candidate architects (refer to Table 3-1). Each registration category requires a unique skill set, level of competency and level of education (SACAP, 2013:29).

Table 3-1: Registration categories for architects

Category	Architecture labour
Professional Architect	
Professional Architect	Advanced conceptual, technical and design work (SACAP, 2013:29).
Professional Senior Architectural Technologist	
Professional Architectural Technologist	Focus on producing and presenting drawings (SACAP, 2013:29).
Professional Architectural Draughtsperson	
Candidate Architect	
Candidate Architect	Candidates obtain architectural experience under supervision of a registered SACAP professional (SACAP, 2017:1).
Candidate Senior Architectural Technologist	
Candidate Architectural Technologist	
Candidate Architectural Draftsperson	

Professional Architects have a high level of education and training which enables them to be involved in various types of architectural projects. They are competent to be involved in and make valuable decisions and contributions at a high level in design, theory, history, technical resolutions and administrative related issues. To register with SACAP as a professional architect, which authorises the architect to sign of

architectural plans, the architect should have a master's degree or equivalent. They must indicate that they completed a two-year supervised candidature and successfully passed the mandatory professional practice exam. With regards to professional senior architectural technologists, their level of competence is focused on a technical level and they have a good understanding of architectural designs (SACAP, 2013:30). Candidate architects are still in training and practice architecture under the supervision of a professional. They do not fulfil the responsibilities of a principal architect, sign off architectural plans or make high-level design decisions (SACAP, 2017:1).

On architectural projects, the professional architect will be involved in a role as a principal architect who has the authority to make design decisions. SACAP (2013:3-4) distinguishes between the roles and responsibilities that a principal agent and principal consultant fulfil:

- i "Principal Agent means the person or entity appointed by the client and who has full authority and obligation to act in terms of the construction contracts." (SACAP, 2013:3).
- ii "Principal Consultant means the person or entity appointed by the client to manage and administer the services of all other consultants." (SACAP, 2013:4).

For the purpose of this research study, the term "principal architect" will refer to the leading professional architect involved in an architectural project, responsible for vetting and approving all design decisions alongside the client.

This research study focused on architects responsible for the design decisions. The sample frame consisted of actively practicing professional architects and professional senior architectural technologists registered with SACAP to fulfil the responsibilities of a principal architect on architectural projects. The respondents who met the above-mentioned criteria and who had an active *LinkedIn* account and/or e-mail address could participate in the research study. However, little information was available on *LinkedIn* as to whether a person was registered with SACAP, therefore, people listed on *LinkedIn* as professional architects, principal architects, architects and candidate architects were approached, bearing in mind that not all the participants would completely meet the target population criteria.

3.4.2.4 Sampling size

Maree and Pietersen (2007c:178) state that having a sufficient sample size is critical to ensure that the larger population is adequately represented and that the data can be generalised. During the process of determining the sample size, the researcher should take response rate and non-response rates into consideration (Oates, 2006:100) as well as the type of statistical analysis that will be applied, the accuracy of results required and the population characteristic (Maree & Pietersen, 2007c:178). In general, a minimum of 30 responses are sufficient for statistical analysis to be performed, however, a large number of responses would better represent the larger population group and more reliable results could be obtained (Maree & Pietersen, 2007c:179).

SACAP agreed to distribute the questionnaire to all the 4,064 professional architects registered on their database, ensuring that all participants would meet the target population criteria. The South African Institute of Architects (SAIA), is a voluntary association for architects which distributed the questionnaire to 500 architects registered on their database and 794 questionnaires were sent to architects. Therefore, the sample size totalled 5,358 participants, of whom 279 gave successful responses to the questionnaire.

3.4.2.5 Response rate and non-responses

A high response rate is preferable as it eliminates the potential of response bias and the data gained from the questionnaire is more reliable, valid and representative (Cook *et al.*, 2000:822; Shih & Fan, 2009:36). If the response rate is low it inhibits the statistical analysis process and statistical biases occur (Rogelberg *et al.*, 2000:284). The following listed factors influence the response rate:

- i The respondent did not receive the survey or difficulties were encountered in completing the questionnaire (Couper, 2000:474; Rogelberg *et al.*, 2000:284).
- ii The respondent forgot to complete and submit the questionnaire (Rogelberg *et al.*, 2000:284).

- iii The participant decided not to participate in the research study (Couper, 2000:473; Rogelberg *et al.*, 2000:284).
- iv The content and topic of the research questionnaire might not be applicable to the participant (Fan & Yan, 2010:133).
- v Kittleson (1997:196) argues that sending more than two reminder notification e-mails results in a lower response rate. This is because participants become overwhelmed by having to working through many e-mails and so become resistant when reminded several times.
- vi The participant might have concerns related to confidentiality (Couper, 2000:474).
- vii According to Cook *et al.* (2000:832), incentives to motivate participants will result in low response rates. If incentives are used when the questionnaire is too long or monotonous this will jeopardise anonymity.

Cook *et al.* (2000:831,833) states that a high response rate can be obtained through using personalised correspondence which is sent out to a large number of participants. Sending one or two reminder e-mails can increase the response rate, though more than two reminder e-mails might have the opposite effect (Cook *et al.*, 2000:831; Kittleson, 1997:196; Shih & Fan 2009:33).

Of the 279 responses received, only 204 usable ones met the criteria of the target population group (discussed in section 3.4.2.3), that is, a 3.81% response rate.

3.5 DATA COLLECTION TECHNIQUES

Oates (2006:36) defines data “collection techniques” as comprising the process followed to generate empirical data or results. Data generation techniques include interviews, documents, questionnaires and observations. In survey research (as discussed in section 3.4.1), questionnaires are the popular data generation technique used to produce quantitative data (Walliman, 2011:97). As a survey was adopted for

this research study, the following paragraphs focussed on how the questionnaire was developed and implemented.

3.5.1 Questionnaires

Brace (2008:4) believes questionnaires serve as a communication medium between the researcher and respondent. Through the questionnaire, the researcher poses a set of specific questions which follow a certain, pre-determined order. In return, the respondent provides answers or information which is converted into a numerical formation (Brace, 2008:4; Oates, 2006:219; Rattray & Jones, 2007:235). An important principle of questionnaires is that the researcher should carefully design, develop and use the questionnaire to enable the participants to provide meaningful and correct information (Brace, 2008:3,7).

3.5.1.1 Advantages of questionnaires

The following points list the advantages associated with utilising questionnaires:

- i Information is collected in a standardised way as the same questions are presented to various participants in the same way. Therefore, it is easy to interpret the responses (Brace, 2008:4).
- ii The interviewer is absent and cannot influence the respondent. Therefore, bias is eliminated and participant can provide honest answers (Brace, 2008:29).
- iii The participants can complete the questionnaire on their own time (Brace, 2008:31).
- iv Questionnaires are a financial viable and cheap method to utilise (Oates, 2006:229).
- v If the presentation of the questionnaire is good, it is visually appealing to the participants (Brace, 2008:32).

- vi Close-ended questions allow for quick and easy completion and data analysis (Oates, 2006:230).
- vii The participants can review their answers to verify their response and they can alter the response if needed (Brace, 2008:32).
- viii Geographical factors do not limit the distribution and completion of questionnaires (Oates, 2006:230).
- ix The researcher does not require a high level of social or interaction abilities to utilise questionnaires (Oates, 2006:230).

3.5.1.2 Disadvantages of questionnaires

The following points state the disadvantages associated with utilising questionnaires:

- i The participants might misunderstand the questions and provide the incorrect answer (Brace, 2008:7).
- ii The interviewer is absent and cannot provide assistance, support or clarification about the questions (Brace, 2008:33; Oates, 2006:230).
- iii The research cannot obtain more detail from the participants (Oates, 2006:230).
- iv Participants might grow weary in completing the questionnaire and fail to do so (Brace, 2008:17).
- v The participants provide dishonest answers (Brace, 2008:21; Oates, 2006:230).
- vi The potential for bias exists as the questions are answered from the participants' framework, circumstances and interpretation (Brace, 2008:19; Oates, 2006:230).
- vii Participants with poor literacy skills or who are visually impaired might find it difficult or impossible to complete the questionnaire (Oates, 2006:230).

Despite the abovementioned disadvantages, the advantages of using questionnaires for this research study outweighed the disadvantages. A pilot study was conducted with the aim of eliminating and addressing the disadvantages associated with questionnaires (refer to section 3.5.2.6).

3.5.2 Designing and developing the questionnaire

Rattray and Jones (2007:234) assert that a logical, systematic and structured approach should be followed when a questionnaire is being developed and designed. If the questionnaire is poorly developed with little planning it will inhibit the researcher from obtaining high-quality feedback, and interpreting the result will be difficult. Brace (2008:35) stresses the importance of ensuring that the research objectives are clearly formulated before the questionnaire is developed. The research objectives will provide guidance about what questions should be included and will prevent the researcher from including questions of interest which are irrelevant.

The first research objective of this study was to establish the EA of professional architects actively practicing in South Africa. The second objective was to determine the extent to which architects consider incorporating sustainable designs methods into the design of architectural buildings. The final objective was to determine and establish the role EA has in influencing sustainable design considerations.

In the following sub-sections, the various factors that were taken into consideration during the design of the questionnaire for this research study will be discussed.

3.5.2.1 Administration process of the questionnaires

Questionnaires can be completed through self-administration in which the participants complete the questionnaire based on their interpretation and understanding of the questions in their own time and at their own pace (Brace, 2008:110). In contrast, interviewer-administrated questionnaires ensure that the researcher or a group of

trained administrators provide assistance and clarification of the questionnaire (Brace, 2008:22).

For the purpose of this research study, the questionnaires were self-administered as the researcher was not involved during the completion process and the participants could complete the questionnaire at their own pace during a convenient time (Brace, 2008:31-32).

3.5.2.2 Content and wording of the questions

The way that questions are phrased and the words used are significant in helping ensure that valuable answers are gathered from the questionnaires (Leung, 2001:187; Oates, 2006:221). Consulting with experts involved in the field of interest and potential participants can provide valuable insight regarding the suitable wording and phrasing (Rattray & Jones, 2007:237). Conducting a literature review related to the research topic ensures that the correct concepts are used (Oates, 2006:221). Rattray and Jones (2007:237) recommend that a pilot study be conducted to refine the phrase, words and content of the questionnaire (refer to section 3.5.2.6).

3.5.2.3 Type of questions

Oates (2006:222) highlights that factual data and options should be gathered from the questions posed. The questions can be classified as open-ended (unstructured) or closed-ended (structure) types. The former gives the participant an opportunity to provide his or her own explanation or comment, whereas the latter restrict the respondent to selecting a suitable answer pre-defined by the researcher (Maree & Pietersen, 2007b:161; Oates, 2006: 222).

Close-ended questions were used in the questionnaire as the participants had to select the pre-defined statement or option suitable to them (refer to annexure B). Certain questions had an option to choose *other* if none of the listed options were applicable and a blank space was available for them to provide additional answers (refer to

annexure B, section 1 questions 1.3; 1.4; 1.5; and 1.9). No open-ended questions were incorporated into the questionnaire. The benefits of the closed-ended question are that it is easy and quick for the participant to complete the questionnaire and the data can easily be quantitatively analysed (Rattray & Jones, 2007:187).

3.5.2.4 Format of the questions and responses

Questions can be posed in various forms, such as multiple-choice, agree or disagree statements, choice of categories, Likert scale and differential scales (Maree & Pietersen, 2007b:161-167; Rattray & Jones, 2007:188).

Section 1 of the questionnaire, mostly consisted of multiple-choice questions as various options were listed and the respondents had to select the answer applicable to their unique circumstances (refer to annexure B, section 1 questions 1.1; 1.3; 1.4; 1.5; 1.6; and 1.9). Various fill-in format questions were provided in section 1, which is neither classified as open nor closed questions. Fill-in questions provide a statement or question with a blank space in which the participant could type in a one or two-word answer (refer to Annexure B, section 1 questions 1.2; 1.7; and 1.8).

Section 2 of the questionnaire (refer to annexure B, section 2) used a Likert scale as the respondents had to indicate the extent to which they agree or disagree with the statements (the scale options entailed: 1 = *Strongly agree*; 2 = *Partially agree*; 3 = *Partially disagree* and 4 = *Strongly disagree*).

In section 3 of the questionnaire (refer to annexure B, section 3), a Likert scale was also adopted but the participants had to indicate to what extent they consider implementing certain sustainable design methods (the scale options entailed: 1 = *Always*; 2 = *Often*; 3 = *Seldom*; 4 = *Never* and N/A = *Not Applicable*).

3.5.2.5 Layout and structure

Layout and structure refer to the availability of necessary information and instructions about the research study and questionnaire. In addition, the questionnaire should follow a logic and ordered sequence (Oates, 2006:225-226).

Oates (2006:226) suggests that the following information should be available to the participants:

- i An introduction explaining the purpose of the research study along with instructions on how the participant should return the questionnaire.
- ii A statement re-ensuring participants that their identity will remain anonymous and data remain confidential.
- iii The participants should be informed that their participation is voluntary.
- iv Instructions regarding how the questionnaire should be completed must be provided.
- v The participants should be thanked for their participation.

The layout of the questionnaire remained consistent throughout the whole questionnaire. Each section started on a new page and instructions were provided throughout the questionnaire to ensure clarity about what was expected. The questionnaire consisted of the following three sections (refer to annexure B):

- i Section 1 (question 1.1 to 1.9) was developed with the aim of collecting basic demographic information.
- ii Section 2 measured the EA of the respondents. The section consisted of a total of 16 statements on a Likert scale in which participants should have indicated the extent to which they agree or disagree with each statement (1 being *strongly agree* and 4 being *strongly disagree*). In the following table (Table 3-2) the 12 dimensions (first-order factors, as previously discussed in section 2.3.5.4) are listed along with the associate statement numbers from the questionnaire. The

“P” and “U” provides an indication as to whether the scale relates to the preservation second-order factor (P) or the utilisation second-order factor (U).

- iii Section 3 measured the sustainable design methods which were categorised into three main sub-sections: (1) economy of resources; (2) life-cycle design; and (3) humane design. Section 3 comprised of a total of 43 statements on a Likert scale in which the participants had to indicate how often the specific sustainable methods are considered during the design stage of architectural projects (1 being *always* and 4 being *never*). For the purpose of the statistical analysis, when the option *not applicable* was chosen the data was considered as missing data.

Table 3-2: EA scales and associated statements in the questionnaire

Scale no.	Scale label	Statement in the questionnaire
P 1	Scale 1: Enjoyment of nature	Statement 2.1 and 2.2
P 2	Scale 2: Support for interventionist conservation policies	Statement 2.3
P 3	Scale 3: Environmental movement activism	Statement 2.4
U 4	Scale 4: Conservation motivated by anthropocentric concern	Statement 2.5 and 2.6
U 5	Scale 5: Confidence in science and technology	Statement 2.7
P 6	Scale 6: Environmental fragility	Statement 2.8
U 7	Scale 7: Altering nature	Statement 2.9
P 8	Scale 8: Personal conservation behaviour	Statement 2.10
U 9	Scale 9: Human dominance over nature	Statement 2.11
U 10	Scale 10: Human utilisation of nature	Statement 2.12
P 11	Scale 11: Ecocentric concern	Statement 2.13 and 2.14
P 12	Scale 12: Support for population growth policies	Statement 2.15 and 2.16

In the covering letter (refer to annexure A) the aim of the research study was explained and the participants were reassured about confidentiality and voluntary participation.

The deadline date was stated along with instructions on how the web-based questionnaire should be submitted.

The number of mandatory questions to complete was kept to a minimum as participants might become frustrated if they were forced to provide answers, and as a result fail to complete the questionnaire (Pretorius, 2017). However, all the questions and statements provided in section 2 and 3 of the questionnaire were mandatory so as to ensure that the data was complete (refer to annexure B).

3.5.2.6 Pre-test and pilot study

A pre-test is defined as a process in which the content of the questionnaire is provided to a small group of experts or authorities in the field of interest for review and comments. A pilot study entails providing the questionnaire to a small group of people who meet the criteria of the target participant population to complete as if they were participating in the final research study. They complete the questionnaire, evaluate it and provide feedback (Oates, 2006:226). For Rattray and Jones (2007:237), conducting a sufficient pilot study is crucial as items which require clarification or rewording are highlighted.

Maree and Pietersen (2007b:160) points out that through conducting a pilot study it can be established whether the questions convey the same meaning to the respondents. As a result, an indication regarding the validity and reliability of the questionnaire is gained (Brace, 2008:175). The feedback received from pre-test and pilot study enabled the researcher to understand what difficulties the participants encountered, which questions are vague and which instructions unclear. The participants will provide feedback and comments about their general impression and thus essential improvements can be made to the questionnaire before finalisation (Oates, 2006:226-227).

Before the pilot study was performed, a pre-test process was conducted in which two professional architects actively practising in South Africa were consulted regarding the wording, suitable phrasing and content. Literature resources were also reviewed to verify the concepts and words used in the field of architecture (Oates, 2006:221). The feedback from the pre-test process was incorporated and the questionnaire for the pilot

study devised. The questionnaire for the pilot study underwent language editing and attention was given to the length of the phases to ensure that the questions were clear, precise and only attended to one piece of information per question (Leung, 2001:187).

Once the questionnaire was finalised, the pilot study was conducted in which the questionnaire was e-mailed to 12 architects practicing in South Africa, of which 8 responses were received.

Feedback from the pilot study highlighted that the reverse questions of the shortened EAI-scale caused confusion and uncertainty about how the questions should be answered. As a result, the shortened EAI-scale developed by Milfont and Duckitt (2010) was adjusted as follows:

- i The reversed statements in the original shortened EAI-scale were revised to positive statements which eliminated the need to reverse the answers during the data analysis process.
- ii In the shortened EAI-scale (Milfont & Duckitt, 2010), two similar statements were available regarding the same scale. However, one statement was formulated as the negative of another statement (e.g., the original shortened EAI-scale posed the following statement: “*Modern science will solve our environmental problems.*” The negative statement entailed: “*Modern science will NOT be able to solve out environmental problems.*”). In order to eliminate confusion, the negative statements were removed from the shortened EAI-scale.

As a result, the EAI-scale used for this research study consisted of a total of 16 statements (refer to annexure B).

Other feedback from the pilot study revolved around better word choices, additional questions that can be incorporated and areas that required clarification. The suggestions and comments gained from the pilot study were taken into consideration and incorporated before finalising the final questionnaire.

Based on the feedback gained from the pilot study, it was noted that not all the sustainable design methods provided in section 3 of the questionnaire were applicable to specific types of architecture projects. To address this, the option to select *not*

applicable was incorporated to the entire section 3 of the questionnaire (refer to annexure B).

3.6 DATA PROCESSING AND ANALYSIS

The objective of data analysis is to make forecasts as well as identify, explain and explore relationships that exist in the collected data (Oates, 2006:245; Walliman, 2011:113). Comments received from the respondents will be qualitatively analysed. Therefore, the following sections will focus on how to analysis and work with quantitative and qualitative data. The associated advantages and disadvantages will also be provided.

3.6.1 Quantitative data analysis

Walliman (2011:113) and Oates (2006:245) noted that quantitative data analysis is utilised for research studies that adopt a positivistic research paradigm and who uses surveys. It translates numerical values through mathematical processes and computer software programs into meaningful information which can be used to explore and understand the topic.

3.6.1.1 Advantages of quantitative data analysis

The following listed points highlight the advantages of performing a quantitative data analysis:

- i Standardised and specialised techniques are used to analyse the data which increases credibility and trustworthiness of the results (Neuman, 2014:479).
- ii Highly-developed and specialised quantitative data analysis software programs can easily analyse large quantities of raw data (Neuman, 2014:479; Oates, 2006:263).

- iii The results presented are based on actual quantities obtained during the data collection process (Oates, 2006:263).
- iv The statistical procedures applied to perform the data analysis can easily be verified and examined by other people (Oates, 2006:263).

3.6.1.2 Disadvantages of quantitative data analysis

Oates (2006:263) highlights the following disadvantages associated with conducting a quantitative data analysis:

- i Researchers might prefer not to work with numbers to perform research.
- ii The researcher is unable to fully comprehend the results obtained from the data analysis.
- iii Before the researcher is able to commence with the data generation process he or she must know which statistical tests will be used.
- iv The level of objectivity is questionable as the researcher can manipulate and influence the numbers and results.

3.6.2 Implementation of quantitative data analysis for this research study

The data was extracted from the online server into an *MS Excel* sheet and coding was performed as well as cleaning the data. Coding transforms raw data into a format that is compatible with statistical analysis computer software (Neuman, 2014:393). The Statistical Package for Social Sciences (SPSS) version 24 is a statistical analysis software package used to perform the quantitative data analysis (Muijs, 2004:85). The following sections will discuss the data analysis procedures that are relevant to this research study.

3.6.2.1 Descriptive statistics

Pietersen and Maree (2007a:183) explain that descriptive statistics entails using statistical methods to provide a meaningful summary of the collected data related to the frequencies (N), means (\bar{x}) and standard deviation (s) (Muijs, 2004:133).

Frequencies provide information regarding how many respondents selected a specific answer to the relevant question. The values acquired from the respondents are presented in numerical and percentage format alongside the associated response categories listed (Muijs, 2004:91; Walliman, 2011:117). The frequencies were calculated for this study to provide an indication about the number of respondents that selected a certain answer to the questions posed in the questionnaire.

The mean (\bar{x}), also known as arithmetic average, is applied to measure central tendencies that exist. The mean is calculated by taking the sum of the scores obtained then dividing it by the number of values (Walliman, 2011:399). The mean is generally presented along with the standard deviation because it provides an estimation about the extent that the data deviates from the mean (Muijs, 2004:107). The mean, as well as the standard deviation, was used in the descriptive statistics for this study.

3.6.2.2 Measurement for reliability

The objective of measuring reliability is to determine the extent to which the data do not consist of measurement error. Cronbach Alpha (α) is the mostly applied statistical technique used to measure internal consistency reliability between constructs. The results provide an indication as to how well the items in the questionnaire measure the specific construct (Muijs, 2004:73).

The reliability is interpreted by evaluating whether the alpha coefficient is close to one or zero. A high reliability occurs when the alpha coefficient is close to one (e.g., 0.90 is considered a high reliability) whereas an alpha coefficient close to zero indicates a low reliability (e.g., 0.40 is considered a low reliability) (Pietersen & Maree, 2007b:216). Cronbach alpha was used in this study to determine the internal reliability of the constructs measured in the questionnaire.

3.6.2.3 Correlation analysis

Walliman (2011:121) explains that correlation coefficients are calculated when the researcher would like to determine whether a linear relationship exists between two variables. A positive relationship means that one variable is related to or corresponds with another variable. Pietersen and Maree (2007c:240) explain that if the correlation values are close to one the relationship is interpreted as strong. However, when the correlation values are close to zero a weak relationship between the variable exist. A perfect positive relationship occurs when the correlation value is $r = +1.000$ and when the correlation value is $r = -1.000$, a perfect negative relationship exists.

This research study used the Spearman's correlation coefficient (Spearman's rho, r_s) to indicate the relationship that exists between variables. The practical significant relationship will be mentioned in this research study (r). The following table (Table 3-3) shows how it will be used to interpret the correlation coefficient:

Table 3-3: Correlation coefficient

r	Interpretation
0.1	No practical significate relationship
0.3	Practical visible relationship
0.5	Practical significant relationship

3.6.3 Qualitative data analysis

Walliman (2011:130) explains that the qualitative data analysis process does not focus on numerical data but on non-numerical data, which is expressed through words, images or sounds. The content of the data is rich, detailed and context-specific (Neuman, 2014:479). The objective of the qualitative data analysis process is to engage with and explore the data richness (Howitt, 2010:329).

3.6.3.1 Advantages of qualitative data analysis

The advantages of adopting a qualitative data analysis process entail:

- i The researcher can identify patterns and relationships in the data during the data collection process (Neuman, 2014:479).
- ii Quotations can be incorporated in the discussion of the data, enabling a better understanding. In addition, quotations can serve as supporting evidence of the interpretation, contributing to the adequacy of the analysis (Howitt, 2010:346).
- iii The data is detailed and can support more than one explanation. Although this can be an advantage it can also be a disadvantage (Neuman, 2014:479).

3.6.3.2 Disadvantages of qualitative data analysis

The main disadvantages of qualitative data analysis are:

- i The qualitative data analysis techniques used are not as standardised as the techniques available to perform quantitative data analysis (Neuman, 2014:478).
- ii The researcher does not specifically know what data analysis technique will be used before the data gathering process commences (Neuman, 2014:478).
- iii The data might embed more than one meaning (Neuman, 2014:479).
- iv Due to the volume of data gathered, the researcher can become overwhelmed with identifying patterns and themes (Oates, 2006:277).

3.6.4 Implementation of qualitative data analysis for this study

The questionnaire of this research study did not have any open-ended questions and participants were not requested to provide comments or feedback. However, e-mails were received from respondents with opinions, recommendations and comments.

Oates (2006:266) recommends that once any qualitative data is gained during the data collection process it should be analysed and incorporated into the research study.

3.6.4.1 Thematic data analysis

Thematic analyses involve working through the quantitative data and identifying themes within the content (Braun & Clarke, 2006:79). The main purpose of thematic analysis is to identify patterns, however, similarities and contrasts can be highlighted (Braun & Clarke, 2006:79). Thematic data analysis can be performed from a semantic or latent approach. Following a semantic approach entails analysing the explicit meaning of the data and the researcher does not interpret underlying meanings which the respondent did not state or write. In contrast, a researcher following a latent approach explores the underlying meaning ideas, notions and assumptions in the data (Braun & Clarke, 2006:84).

In order to perform a thematic analysis, coding is conducted to represent the various themes identified (Guest *et al.*, 2012:10). This entails sorting the data into meaningful analytical units then assigning a code or symbol to the key theme (Nieuwenhuis, 2007c:105). A frequency count was performed to determine how many times each code occurred and the frequencies will be provided for reporting purposes (Leech & Onwuegbuzie, 2008:596).

The content of the e-mails and *LinkedIn* messages were semantically approached and themes were created along with subthemes that related to the main theme created. Each message was labelled with a number (Respondent #1 to Respondent #12) to anonymise the participant and allow correct reference to the e-mail message received.

3.7 SUMMARY

In this chapter the research methodology used for this research study was discussed. The positivistic research paradigm applicable to it was briefly outlined along with the qualitative research approach followed. The chapter presented the way that the survey

was conducted by developing and implementing a questionnaire for the data collection. The procedure followed to obtain the data through *Google Forms* was explained along with the statistical analysis performed for this research study. The results that were gathered from the questionnaire will be provided and discussed in chapter 4.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 INTRODUCTION

In chapter 3, the research methodology used for this study, along with the means of implementation was discussed. The results obtained from the questionnaire and the data analysis will be presented in this chapter, the structure consisting of a discussion regarding the questionnaire in accordance with the layout and sections as it appears in the questionnaire (refer to annexure B). As discussed in section 3.4.2.4, a total of 5,358 questionnaires were sent out to architects in South Africa. A total of 279 were sufficiently completed and submitted, however, only 204 ($N = 204$) could be used for this research study as others did not meet the criteria of the target population group (as discussed in section 3.4.2.3). The response rate was calculated as 3.81% (as discussed in section 3.4.2.5).

4.2 SECTION 1: INDIVIDUAL BACKGROUND INFORMATION

Section 1 of the questionnaire (refer to annexure B) obtained basic demographic information of the respondents through the following nine questions: (1) Gender; (2) Age; (3) Highest level of qualification; (4) Professional registration category; (5) Primary field of professional activity; (6) Number of projects assigned the responsibilities of a principal architect; (7) Years of experience as an architect with an undergraduate qualification; (8) Years of experience as an architect with a postgraduate qualification; and (9) Field of architectural expertise. The data from these nine questions will be presented in the next paragraphs.

4.2.1 Gender and age

Most of the respondents ($N = 204$) were male (75.0%) and 25.0% were female. The average age of the respondents was 41.71 years with a standard deviation of 12.34.

4.2.2 Qualification

Table 4-1 presents the highest level of qualification obtained by the participants (refer to question 1.3 in annexure B). As discussed in section 3.4.2.3, a master's degree is the minimum level of education required to register as professional architect with SACAP, however, it is possible to be a registered professional architect at SACAP without one, based on the years of experience. As indicated in Table 4-1, 63.7% of the participants held a master's degree qualification as their highest qualification and 0.5% held a doctoral degree.

The participants were provided with the option of stating any other level of education they had obtained not already listed (refer to question 1.3 in annexure B). A total of five participants chose this option and the following educational levels were provided: architectural professional registration, Bachelor of Arts Honours, Bachelor of Architecture 1994 (now equivalent to a Master of Architecture), Diploma of Architecture and Master of Business Administration (MBA).

Table 4-1: Percentage of the qualification level

Qualification level	Frequency (N)	Valid percentage	Cumulative percentage
Bachelor's degree	42	20.6%	20.6%
Postgraduate / Honours degree	26	12.7%	33.3%
Master's degree	130	63.7%	97.0%
Doctoral degree	1	0.5%	97.5%
Other	5	2.5%	100.0%

4.2.3 Professional registration category

Question 1.4 (refer to annexure B) determined the current status of the respondents' professional registration category with SACAP.

The Architectural Professions Act (44 of 2000) acknowledges eight categories: (1) professional architect; (2) professional senior architectural technologist; (3) professional architectural technologist; (4) professional architectural draughtsperson; (5) candidate architect; (6) candidate senior architectural technologist; (7) candidate architectural technologist; and (8) candidate architectural draughtsperson, which architects can be registered as in South Africa (refer to section 3.4.2.3 and Table 3-1). For the purpose of this study the focus was on the professional architects and professional senior architectural technologist (as discussed in section 2.4.2.3).

Out of the total 204 responses, 93.1% of the participants were registered with SACAP as professional architects and 6.9% were professional senior architectural technologists.

4.2.4 Primary field of professional activity

Figure 4-1 provides an indication of the main architectural activity in which the participants engaged daily (refer to question 1.5 in annexure B). Most participants (59.4%) indicated that they were involved in such projects as the design, construction, project and site architecture. The minority were involved in projects as a site architect (57.8%) or construction architect (58.3%), whilst the majority acted as design architect (77.0%) and a total of 70.6% as project architect.

The participants were provided with the option of indicating any other professional activities not already listed which they conduct because they can be architects who fulfil other roles and tasks (refer to question 1.5 in annexure B). A total of nine chose this option and provided the following architectural positions they held: academic lecturer, business developer, partner, sustainable building consultant, architectural fire engineer and retired architect.

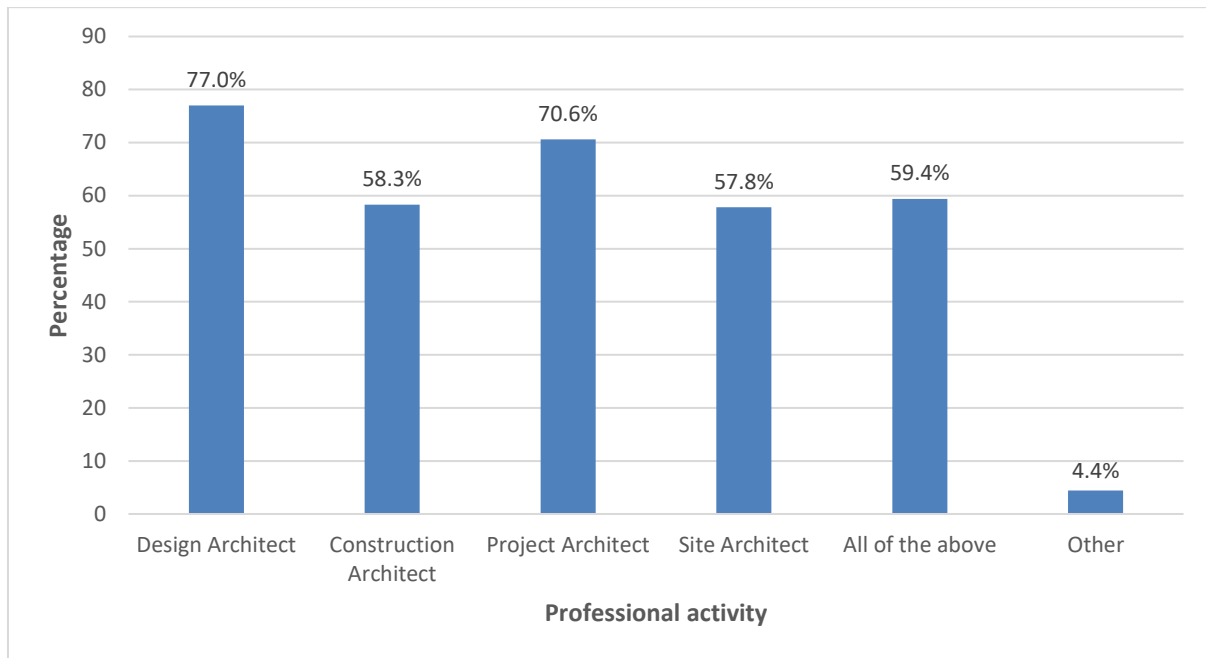


Figure 4-1: Professional architectural activity engaged in

4.2.5 Involved in projects as principal architect

Question 1.6 of the questionnaire (refer to annexure B) established the extent to which the participants had been assigned the responsibilities of principal architect on projects over the previous five years. A small number (10.3%) indicated that they had fulfilled the responsibilities of a principal architect on 10 to 14 projects, whereas 38.2% were involved in one to four projects as the principal architect. Only 27.5% were involved in 15 or more projects, and 24.0% in five to nine projects as the principal architect.

4.2.6 Architectural experience with an undergraduate and a post-graduate qualification

The respondents were asked in question 1.7 (refer to annexure B) to state the number of years of experience they had as an architect with an undergraduate qualification. The average number of years of experience totalled 6.84 years with a standard deviation of 8.7. A total of 14.2% of the respondents stated they only had one year of

architectural experience with an undergraduate qualification. In addition, 12.3% of the participants had two-year experience and 6.9% had five years of experience with an undergraduate qualification. The highest number of years of experience recorded by 0.5% of the participants with an undergraduate qualification was 48 years.

The follow-up question related to the number of years of experience the participants had as architect with a postgraduate qualification (refer to question 1.8 in annexure B). On average, this was 13.9 years with a standard deviation of 12.1. A total of 7.0% of the respondents stated that they had 10 years of work experience on a postgraduate level. The highest time of work experience indicated by 0.5% of the participants was 57 years (with six years of work experience with an undergraduate qualification, with 51 years of experience with a postgraduate qualification). A total of 7.0% of the respondents stated that they had four years of postgraduate experience and 6.5% indicated five years of postgraduate experience.

4.2.7 Field of architectural expertise

Figure 4-2 provides an illustration of the various types of architectural projects the participants specialised in (refer to question 1.9 in annexure B). It was indicated by 81.8% that they specialised in residential projects. A total of 64.7% indicated that they specialised in commercial projects and 35.8% in governmental projects. The minority specialised in healthcare (29.4%), hotel and leisure projects (25.0%) and high-rise buildings (14.7%).

The participants were provided with the option of indicating any other field of architectural expertise not already listed, and a total of 40 chose this option. The following types of architectural projects were provided: educational institutions, places of worship, industrial, sport facilities, offices, shopping centres, community projects, heritage and museums, theatre, sustainable design, mixed developments, wine production and cellars, airports, railway stations, rehabilitation of existing buildings, universal access, science and technology, interior, infrastructure and transportation interchanges.

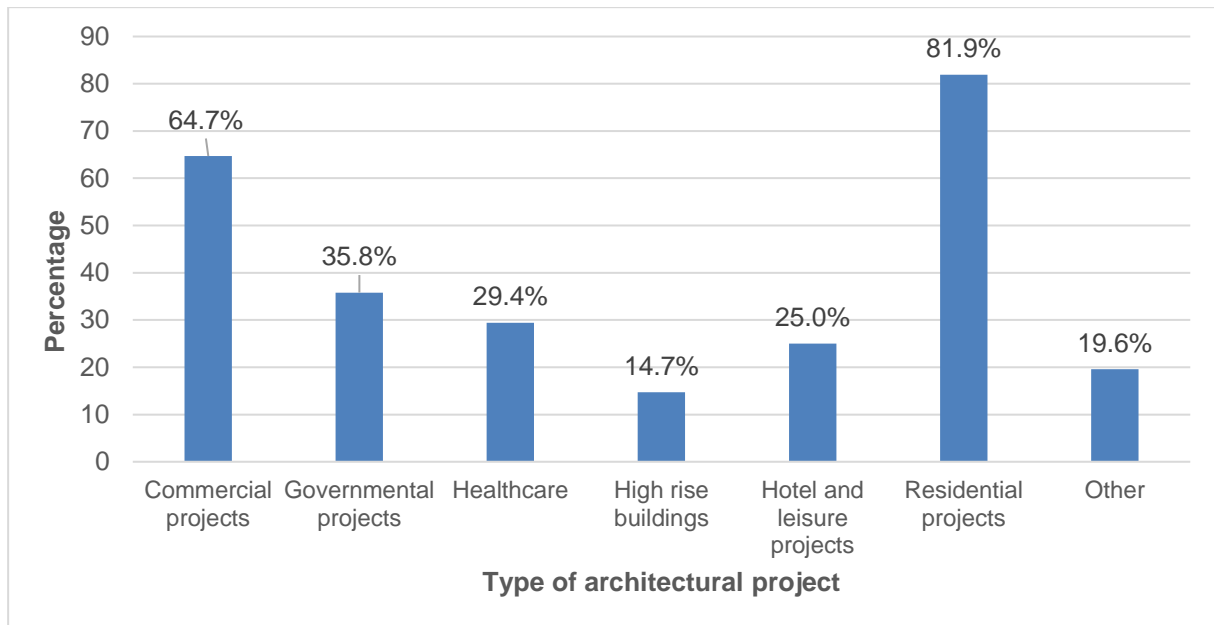


Figure 4-2: Field of architectural expertise

4.3 SECTION 2: THE ENVIRONMENTAL ATTITUDES INVENTORY SCALE

The revised shortened EAI-scale was adopted for this research study to determine the EA of the respondents (Milfont & Duckitt, 2010, refer to sections 2.3.6 and 2.5.2.6). The scale determines two main second-order factors (preservation and utilisation) which consist of several different first-order factors (as discussed in section 2.3.5.4 and Table 2-1). In this section, the preservation second-order factor as well as utilisation second-order factor and their associated first-order factors will be provided and discussed respectively. This section will be concluded by summarising the statistical data obtained from the revised shortened EAI-scale.

The revised shortened EAI-scale was provided in section 2 of the questionnaire and consisted of 16 statements (numbered 2.1 to 2.16). Ten of the 16 statements related to preservation and six to utilisation (refer to Table 3-2). The responses were measured with a Likert scale and the respondents had to indicate the extent to which they agreed or disagreed with each statement (scale options entailed: 1 = *Strongly agree*; 2 = *Partially agree*; 3 = *Partially disagree* and 4 = *Strongly agree*).

4.3.1 Preservation scales

Statements 2.1, 2.2, 2.3, 2.4, 2.8, 2.10, 2.13, 2.14, 2.15 and 2.16 in the revised shortened EAI-scale measured the seven first-order factors related to preservation (scales P 1; 2; 3; 6; 8; 11 and 12) (refer to annexure B and Table 3-2). The participants on average *partially agreed* to the preservation scale related statements ($\bar{x} = 1.76$ out of 4; $s = 0.47$). The results of the Cronbach alpha analysis for the preservation scales indicated a high reliability with the coefficient (α) of 0.73.

Table 4-2: Summary of preservation scales

Environmental Attitudes							
Preservation scales							
Scale	State- ment	<i>Strongly agree</i> (1)	<i>Partially agree</i> (2)	<i>Partially disagree</i> (3)	<i>Strongly disagree</i> (4)	Mean (\bar{x})	Std. Div.
P 1	2.1	71.6%	21.6%	2.5%	4.4%	1.40	0.746
P 1	2.2	76.5%	18.1%	2.5%	2.9%	1.32	0.667
P 2	2.3	54.4%	29.9%	11.3%	4.4%	1.66	0.848
P 3	2.4	17.2%	44.6%v	27.5%	10.8%	2.32	0.883
P 6	2.8	73.0%	18.1%	3.9%	4.9%	1.41	0.785
P 8	2.10	54.9%	36.3%	5.9%	2.9%	1.57	0.736
P 11	2.13	26.5%	49.5%	19.6%	4.4%	2.02	0.800
P 11	2.14	77.9%	12.3%	2.0%	7.8%	1.40	0.868
P 12	2.15	35.3%	25.5%	19.6%	19.6%	2.24	1.133
P 12	2.16	18.6%	25.5%	26.0%	29.9%	2.67	1.094
		(\bar{x})	1.7647	Std. Div.	0.4664	(α)	0.726

4.3.1.1 Scale 1: Enjoyment of nature

Statement 2.1 and 2.2 in the questionnaire (refer to annexure B) determined the extent to which the participants enjoy spending time in nature. Based on the results provided in Table 4-2 (statement 2.1 in annexure B), it is apparent that 93.2% of the respondents

preferred being in the bushveld or nature reserves, whereas 6.9% indicated the opposite. Significantly, however, 4.4% of the respondents indicated that they did not prefer being in the bushveld or nature reserves (refer to Table 4-2, statement 2.1 in annexure B), and only 2.9% indicated that they did not prefer spending time in nature (refer to Table 4-2, statement 2.2 in annexure B). The majority, 76.5%, indicated that they preferred spending time in nature (refer to Table 4-2, statement 2.2 in annexure B).

4.3.1.2 Scale 2: Support for interventionist conservation policies

When asked, in statement 2.3 (refer to annexure B), whether governments should control the rate at which raw materials were utilised to ensure that they last for a long time, 84.3% of the respondents indicated that they agreed and only 15.7% disagreed with this statement (refer to Table 4-2).

4.3.1.3 Scale 3: Environmental movement activism

The overall response to the notion of joining and participating in environmentalist groups (refer to statement 2.4 in annexure B) was positive. Most of the respondents (61.8%) indicated that they were willing to be involved in environmental activist groups and the remaining 38.3% were not (refer to Table 4-2).

4.3.1.4 Scale 6: Environmental fragility

The results in Table 4-2, related to statement 2.8 (refer to annexure B), indicated that the majority of the respondents (73.0%) believed that severe environmental harm is caused by human activities.

4.3.1.5 Scale 8: Personal conservation behaviour

As indicated in Table 4-2 (refer to statement 2.10 in annexure B), it is apparent that the majority of the respondents (91.2%) focussed on conserving natural resources through their personal behaviour.

4.3.1.6 Scale 11: Ecocentric concern

Based on the results obtained in Table 4-2, the overarching number of respondents experienced a sense of concern regarding environmental loss and harm (refer to statement 2.13 and 2.14 in annexure B). A total of 90.2% indicated that seeing the natural environment being destroyed was of concern to them (refer to statement 2.13 in annexure B), but when asked whether seeing the natural environment cleared for agricultural purposes, a lower level of concern was noted, with 77.9% of the respondents indicating concern.

4.3.1.7 Scale 12: Support for population growth policies

From the results obtained from statement 2.15 and 2.16 (refer to annexure B and Table 4-2), a positive attitude towards limiting population growth was noted. A total of 60.8% indicated that families should be limited to having two or fewer children (refer to statement 2.15 in annexure B), and 44.1% that people should be allowed to have as many children as they chose (refer to statement 2.16 in annexure B). However, the results for statement 2.16 (refer to annexure B) also showed that a total of 55.9% of the respondents indicated that even though the families could provide and take care of many children they should not have as many as they wanted.

4.3.2 Utilisation scales

In the revised shortened EAI-scale, six statements (statement 2.5, 2.6, 2.7, 2.9, 2.11, 2.12) related to five first-order factors on utilisation (scales U 4; 5; 7; 9 and 10) (refer

to annexure B and Table 3-2). The participants on average indicated that they *partially agreed* with the utilisation related statements ($\bar{x} = 1.93$ out of 4; $s = 0.47$). The results of the Cronbach alpha analysis for the utilisation scales indicated a moderate reliability with the coefficient (α) of 0.51.

Table 4-3: Summary of utilisation scales

Environmental Attitudes							
Utilisation scales							
Scale	State- ment	<i>Strongly agree</i> (1)	<i>Partially agree</i> (2)	<i>Partially disagree</i> (3)	<i>Strongly disagree</i> (4)	Mean (\bar{x})	Std. Div.
U 4	2.5	10.3%	22.1%	32.4%	35.3%	2.93	0.992
U 4	2.6	84.8%	10.8%	1.5%	2.9%	1.23	0.618
U 5	2.7	13.2%	37.7%	36.3%	12.7%	2.49	0.879
U 7	2.9	37.7%	38.2%	17.6%	6.4%	1.93	0.899
U 9	2.11	10.8%	17.6%	27.0%	44.6%	3.05	1.028
U 10	2.12	4.9%	14.2%	4.5%	32.4%	3.08	0.811
		(\bar{x})	1.934	Std. Div.	0.474	(α)	0.51

4.3.2.1 Scale 4: Conservation motivated by anthropocentric concern

As discussed in Table 2-1 (scale 4), being concerned about the environment can be motivated by human-centred interests or an earth-centred viewpoint. When asked in statement 2.5 (refer to annexure B) whether they considered it more important to keep dams and rivers clean for human-centred interest, such as enjoying water sports, 72.0% of the participants *strongly disagreed* with this statement (refer to Table 4-3).

Statement 2.6 (refer to annexure B) posed the opposite question from statement 2.5 and the participants were asked whether they thought that rivers and dams should be kept clean to protect the environment. A total of 84.8% of the participants indicated that they *strongly agreed* with this statement (refer to Table 4-3), therefore, based on the data obtained from statement 2.5 and 2.6 it can be concluded that the participants'

motivation to conserve the environment was driven by a life and earth-centred concern rather than an anthropocentric one.

4.3.2.2 Scale 5: Confidence in science and technology

On the ability of technology, science and ingenuity to solve or repair environmental harm the disparity in response was small (refer to statement 2.7 in annexure B), with a total of 50.9% agreeing with the statement and 49.1% disagreeing (refer to Table 4-3).

4.3.2.3 Scale 7: Altering nature

To determine the attitude held towards the belief that people should have the right to alter the environment, the question was posed as to whether the respondents preferred a natural, wild growing garden (refer to statement 2.9 in annexure B). The overall results indicated that 75.9% of the respondents preferred a wild, natural garden above a well-maintained one, which in effect provided an indication that the respondents believed that the original state of the natural environment should be preserved (refer to Table 4-3).

4.3.2.4 Scale 9: Human dominance over nature

The majority of the respondents (71.6%) indicated that they did not think that humans were created to dominate nature (refer to Table 4-3, statement 2.11 in annexure B). However, 28.4% indicated that they did believe humans were created to dominate nature (refer to Table 4-3, statement 2.11 in annexure B), therefore, when exploring the notion of human dominance over nature it is clear from the results that nature was not regarded as primarily existing for human consumption.

4.3.2.5 Scale 10: Human utilisation of nature

Human utilisation of nature is concerned with a belief that economic growth is a higher priority than protecting the environment (refer to statement 2.12 in annexure B). Based on the results presented in Table 4-3, most of the respondents (80.9%) indicated that protecting the environment is more important than protecting the jobs of people. Based on the data obtained in this scale (scale 10) and scale 7 (discussed in section 4.3.2.3), the information concurs. The participants indicated in scale 10 that it was important to protect the environment and in scale 7 that the original state of the natural environment should be preserved. Therefore, although scales 10 and 7 measure utilisation, the responses of the participants illustrate a pro-environmental orientation.

4.3.3 Results of the revised shortened EAI-scale

This section provides a summary of the statistical data obtained from the revised shortened EAI-scale. The results of the Cronbach alpha analysis for the revised shortened EAI-scale indicated a high reliability with the coefficient (α) of 0.63.

The results of the revised shortened EAI-scale indicated that the respondents on average agreed to the statements relating to the preservation scale ($\bar{x} = 1.76$ out of 4; $s = 0.47$). With regards to the utilisation scales, the respondents on average agreed to the utilisation related statements ($\bar{x} = 1.93$ out of 4; $s = 0.47$). Calculation of the EA of the participants was made by determining the overall score of the revised shortened EAI-scale and the respondents on average *partially agreed* to the scale items ($\bar{x} = 1.83$ out of 4; $s = 0.41$). The Likert scale options 1 = *strongly agree*; 2 = *partially agree* relate to a concerned EA towards the natural environment, whereas options 3 = *disagree* and 4 = *strongly disagree* are interpreted as an unconcerned EA towards the natural environment. Therefore, the participants had a concerned EA towards the natural environment and its quality.

The Spearman's correlation coefficient (r) was calculated to establish the relationship between EA and the following listed variables (the p -values will be reported for

completeness but will not be interpreted, since an availability sample was used instead of a random sample):

i Age of the participants

Negative relationships were found between age and the EA of the participants ($r = -0.042$; $p > .05$); the preservation scales ($r = -0.043$; $p > .05$) as well as the utilisation scales ($r = -0.063$; $p > .05$). These were practical non-significant relationships.

ii Number of projects involved as the principal architect

Negative relationships were found between the number of projects involved as the principal architect and the EA of the participants ($r = -0.044$; $p > .05$), the preservation scales ($r = -0.022$; $p > .05$) as well as the utilisation scales ($r = -0.075$; $p > .05$). These were also practical non-significant relationships.

iii Number of years of experience with an undergraduate qualification

Positive relationships were found between number of years of experience with an undergraduate qualification and the EA of the participants ($r = 0.020$; $p > .05$), the preservation scales ($r = 0.006$; $p > .05$) and the utilisation scales ($r = 0.065$; $p > .05$). However, all the above-mentioned were practical non-significant relationships.

iv Number of years of experience with a postgraduate qualification

Negative relationships were found between number of years of experience with a postgraduate qualification and the EA of the participants ($r = -0.071$; $p > .05$), preservation scales ($r = -0.063$; $p > .05$) and the utilisation scales ($r = -0.086$; $p > .05$). These were all practical non-significant relationships.

4.4 SECTION 3: SUSTAINABLE DESIGN METHODS

Section 3 of the questionnaire determined the extent to which architects considered incorporating sustainable design methods into the design of architectural buildings (Jong-Jin & Rigdon, 1998:1-28, discussed in section 2.4.4.4). This section of the questionnaire was categorised into three sub-sections: (1) economy of resources; (2) life-cycle design; and (3) humane design (refer to annexure B). In this section, the information obtained for each of the three sub-sections will be provided and discussed respectively. This section will be concluded with a summary of the overall data obtained in section 3 of the questionnaire.

A Likert scale measurement was used, and the participants had to indicate the extent to which they consider implementing certain sustainable design methods (scale options entailed: 1 = *Always*; 2 = *Often*; 3 = *Seldom*; 4 = *Never*, and N/A = *Not Applicable*).

4.4.1 Sub-section 3.1: Economy of resources

The respondents reacted positively towards the economy of resource design measurements because on average they indicated that they *often* considered these sustainable design methods ($\bar{x} = 2.01$ out of 4; $s = 0.47$). The internal consistency of the various constructs in sub-section 3.1 was calculated and the results of the Cronbach alpha analysis indicated a high reliability with the coefficient (α) of 0.89.

The results provided in Table 4-4, indicated that 86.6% of the participants *always* took into consideration the orientation of a building to reduce energy consumption (refer to statement 3.1.2 in annexure B) and 87.3% *always* considered optimising the utilisation of natural daylight (refer to statement 3.1.8 in annexure B).

Considering use of passive solar energy in designs scored highly, with 68.1% of the respondents indicating that they *always* considered passive solar energy and 24.0% *often* (refer to Table 4-4, statement 3.1.3 in annexure B).

Incorporating materials which consist of insulation properties to prevent heat gain or loss was another economy of resource measurement which scored a positive

response. Most of the respondents indicated that they *always* (55.4%) or *often* (36.3%) incorporated materials with insulation properties to prevent heat gain or loss (refer to Table 4-4, statement 3.1.7 in annexure B).

Despite the positive responses, there were three main economies of resource measurements, with more than half of the respondents indicating they did not consider them in the designs of architectural projects. A total of 53.5% indicated that they did not implement on-site greywater recycling practices (refer to Table 4-4, statement 3.1.12 in annexure B), nor did 76.2% incorporate sewage water recycling practices (refer to Table 4-4, statement 3.1.15 in annexure B). Utilising recycled construction materials for the construction of a new building is the third economy of resource measurement that a total of 65.5% of the respondents indicated they *seldom* (46.0%) or *never* (19.5%) considered this practice (refer to Table 4-4, statement 3.1.18 in annexure B).

Table 4-4: Percentages of economy of resources data

Sustainable design methods						
Economy of resources						
State- ment	<i>Always</i> (1)	<i>Often</i> (2)	<i>Seldom</i> (3)	<i>Never</i> (4)	Mean (\bar{x})	Std. Div.
3.1.1	37.5%	40.6%	17.2%	4.7%	1.89	0.852
3.1.2	86.8%	11.3%	0.5%	1.5%	1.17	0.488
3.1.3	68.1%	24.0%	6.4%	1.5%	1.41	0.678
3.1.4	25.1%	37.9%	28.6%	8.4%	2.20	0.914
3.1.5	35.0%	46.8%	12.3%	5.9%	1.89	0.837
3.1.6	38.9%	36.9%	19.2%	4.9%	1.90	0.879
3.1.7	55.4%	36.3%	5.9%	2.5%	1.55	0.717
3.1.8	87.3%	11.3%	0.5%	1.0%	1.15	0.445
3.1.9	40.9%	45.8%	10.3%	3.0%	1.75	0.757
3.1.10	31.3%	42.9%	21.2%	4.5%	1.99	0.843
3.1.11	17.2%	49.3%	28.6%	4.9%	2.21	0.783
3.1.12	10.5%	36.0%	41.5%	12.0%	2.55	0.837
3.1.13	24.4%	47.3%	21.4%	7.0%	2.11	0.853

3.1.14	35.5%	45.3%	15.8%	3.4%	1.87	0.798
3.1.15	5.3%	18.5%	38.6%	37.6%	3.08	0.877
3.1.16	28.4%	43.8%	21.4%	6.5%	2.06	0.870
3.1.17	25.0%	46.4%	21.9%	6.6%	2.10	0.853
3.1.18	10.0%	24.5%	46.0%	19.5%	2.75	0.884
3.1.19	12.5%	48.0%	34.0%	5.5%	2.33	0.763
3.1.20	22.8%	36.0%	25.4%	15.7%	2.34	1.001
	(\bar{x})	2.0127	Std. Div.	0.46604	(α)	0.891

4.4.2 Sub-section 3.2: Life-cycle design

The respondents on average indicated that they *often* considered the sustainable design methods related to life-cycle design (\bar{x} = 2.15 out of 4; s = 0.57). The internal consistency of the various constructs in sub-section 3.2 was calculated and the results of the Cronbach alpha analysis indicated a high reliability with the coefficient (α) of 0.84.

Based on the results provided in Table 4-5, it was noticed that 84.9% of the respondents indicated that they would rather redevelop existing buildings or infrastructures to avoid commencing with construction in an undisturbed area (refer to Table 4-5, statement 3.2.8). In addition, 75.5% of the respondents indicated that they did consider how environmental harm could be avoided during the construction process of architectural projects (refer to Table 4-5, statement 3.2.5). A total of 77.9% of the respondents indicated that they did consider the environmental impact of construction materials (refer to Table 4-5, statement 3.2.1).

Statement 3.2.4 (refer to annexure B) determined whether the respondents considered the life-cycle of the materials. A total of 73.2% of the respondents considered the life-cycle of the materials (refer to Table 4-5, statement 3.2.4).

A positive response of 78.0% was found towards utilising non-toxic materials and substances (refer to Table 4-5, statement 3.2.7), whereas fewer respondents (66.8%) considered utilising materials which do not contain ozone-depleting substances (refer to Table 4-5, statement 3.2.6).

When the question was posed regarding utilising materials made from recycled materials (refer to Table 4-5, statement 3.2.2 in annexure B), slightly more respondents indicated *often* (45.3%), compared to 42.9% who indicated that they “*seldom*” used materials that were recycled, or the 3.0% who *never* utilised recycled materials.

Table 4-5: Percentages of life-cycle design data

Sustainable design methods						
Life-cycle design						
State- ment	<i>Always</i> (1)	<i>Often</i> (2)	<i>Seldom</i> (3)	<i>Never</i> (4)	Mean (\bar{x})	Std. Div.
3.2.1	25.0%	52.9%	19.6%	2.5%	2.00	0.739
3.2.2	8.9%	45.3%	42.9%	3.0%	2.40	0.692
3.2.3	7.2%	27.2%	44.1%	21.5%	2.80	0.859
3.2.4	27.2%	46.0%	20.3%	6.4%	2.06	0.856
3.2.5	34.5%	41.0%	20.0%	4.5%	1.95	0.852
3.2.6	25.0%	41.8%	25.0%	8.2%	2.16	0.897
3.2.7	31.0%	47.0%	17.0%	5.0%	1.96	0.826
3.2.8	38.9%	46.0%	12.1%	3.0%	1.79	0.769
	(\bar{x})	2.1452	Std. Div.	0.56580	(α)	0.839

4.4.3 Sub-section 3.3: Humane Design

The respondents on average indicated that they *often* considered the sustainable design methods associated with humane design (\bar{x} = 1.69 out of 4; s = 0.41). The internal consistency of the various questions in sub-section 3.2 was calculated and the results of the Cronbach alpha analysis indicated a high reliability with the coefficient (α) of 0.81.

Overall, 83.8% of the respondents indicated that they *always* conducted a detailed site analysis to ensure that the characteristics were incorporated into the designs of the architectural projects (refer to Table 4-6, statement 3.3.1 in annexure B). A positive response of 93.6% was noted towards protecting existing vegetation and habitats during construction (refer to Table 4-6, statement 3.3.4 in annexure B) and 93.1% of

the respondents incorporated the existing vegetation and habitats into the designs (refer to Table 4-6, statement 3.3.5 in annexure B). However, when statement 3.3.3 (refer to annexure B) was posed, regarding prioritising rehabilitation of the natural environment and habitat once construction was complete, only 83.1% of the respondents valued the rehabilitation process as a priority.

Besides taking into consideration the site characteristics, 83.3% of the respondents *always* considered the needs of the end-user (refer to Table 4-6, statement 3.3.13 in annexure B), but only 43.5% of the respondents *always* ensured that the end-user would be able to regulate the indoor temperature and natural ventilation (refer to Table 4-6, statement 3.3.12 in annexure B).

A total of 67.5% of the respondents indicated that they *always* made provision for physical conditions or disabilities (refer to Table 4-6, statement 3.3.15 in annexure B) in the designs, but only 61.8% of the respondents *always* considered the needs of various age groups (refer to Table 4-6, statement 3.3.14 in annexure B). However, when comparing the overall total of positive responses gained, 95.1% of the respondents accommodated physical conditions or disabilities into the designs (refer to Table 4-6, statement 3.3.15 in annexure B) and 92.7% of the respondents considered the needs of various age groups (refer to Table 4-6, statement 3.3.14 in annexure B).

Encouraging car-sharing by limiting the number of parking spaces for the sole use of priority vehicles showed that only 11.9% of the respondents indicated *always* for the limiting parking spaces and only 22.2% of the respondents indicated *often*. A total of 43.8% of the respondents *seldom* encouraged car-sharing through the architectural designs (refer to Table 4-6, statement 3.3.9 in annexure B).

Table 4-6: Percentages of humane design data

Sustainable design methods						
Humane design						
State- ment	<i>Always</i> (1)	<i>Often</i> (2)	<i>Seldom</i> (3)	<i>Never</i> (4)	Mean (\bar{x})	Std. Div.
3.3.1	83.8%	13.2%	2.0%	1.0%	1.20	0.510
3.3.2	36.2%	34.2%	23.6%	6.0%	1.99	0.918
3.3.3	43.8%	39.3%	14.4%	2.5%	1.76	0.791
3.3.4	58.1%	35.5%	4.9%	1.5%	1.50	0.663
3.3.5	52.2%	40.9%	5.9%	1.0%	1.56	0.653
3.3.6	47.4%	38.7%	11.3%	2.6%	1.69	0.773
3.3.7	13.6%	50.8%	29.9%	5.6%	2.28	0.767
3.3.8	37.8%	44.3%	13.5%	4.3%	1.84	0.816
3.3.9	11.9%	22.2%	43.8%	22.2%	2.76	0.932
3.3.10	27.4%	45.7%	23.2%	3.7%	2.03	0.810
3.3.11	75.7%	22.3%	1.0%	1.0%	1.27	0.528
3.3.12	43.5%	43.5%	11.0%	2.0%	1.72	0.739
3.3.13	83.3%	14.7%	1.0%	1.0%	1.20	0.487
3.3.14	61.8%	30.9%	5.9%	1.5%	1.47	0.676
3.3.15	67.5%	27.6%	3.4%	1.5%	1.39	0.630
	(\bar{x})	1.6897	Std. Div.	0.41290	(α)	0.814

4.4.4 Sustainable design methods

This section will provide a summary of the statistical data obtained from the sustainable design method section of the questionnaire (refer to section 3 in annexure B). The results of the Cronbach alpha analysis for the sustainable design method section of the questionnaire indicated a high reliability with the coefficient (α) of 0.85.

The average (\bar{x}) for the entire section 3 of the questionnaire was calculated and the respondents *often* incorporated sustainable design methods into the design of architectural projects (\bar{x} = 1.88 out of 4; s = 0.42).

The Spearman's correlation coefficient (r) was calculated to establish the relationships between sustainable design methods, the associated sub-sections and the following variables. Since an availability sample was used instead of a random sample the p -values will be reported for completeness sake but will not be interpreted:

i Age of the participants

Negative relationships existed between age and sustainable design methods ($r = -.199$; $p < .01$), economy of resource ($r = -.208$; $p < .01$), life-cycle design ($r = -.263$; $p < .01$) and humane design ($r = -0.018$; $p > .05$). However, these are practical non-significant relationships.

ii Number of projects involved as the principal architect

Negative relationships were also found between the number of projects in which the participants were involved as the principal architect and sustainable design methods ($r = -.154$; $p < .05$), economy of resource ($r = -.206$; $p < .01$), life-cycle design ($r = -.163$; $p < .05$) and humane design ($r = -0.043$; $p > .05$). These were also practical non-significant relationships.

iii Number of years of experience with an undergraduate qualification

There was a positive relationship between number of years of experience with a postgraduate qualification and humane design ($r = 0.046$; $p > .05$). However, negative relationships were found between number of years of experience with a postgraduate qualification and sustainable design methods ($r = -0.022$; $p > .05$), economy of resource ($r = -0.052$; $p > .05$) and life-cycle design ($r = -0.046$; $p > .05$). All of the above-mentioned relationships are practically non-significant.

iv Number of years of experience with a postgraduate qualification

Negative relationships between number of years of experience with a postgraduate qualification and sustainable design methods ($r = -.156$; $p < .05$), economy of resource ($r = -.169$; $p < .05$), life-cycle design

($r = -.153$; $p < .05$) and humane design ($r = -.142$; $p < .05$) were found. These were also practically non-significant relationships.

4.5 RELATIONSHIP BETWEEN EA AND SUSTAINABLE DESIGN

Spearman's correlation coefficient (r) was conducted to establish the relationship that exists between the EA of the participants and sustainable design methods, as well as its three sub-sections: (1) economy of resources; (2) life-cycle design; and (3) humane design. The p -values will be reported for completeness but will not be interpreted since availability instead of a random sample was used for this research study.

The information provided in the correlation table (refer to Table 4-7) indicates that a practical non-significant relationship exists between the preservation scales and considering sustainable design methods ($r = 0.227$; $p < .01$). The relationship between the utilisation scales and considering sustainable designs methods was also found to be practically non-significant ($r = 0.060$; $p > .05$). With regards to the EA of the participants, a practical non-significant relationship was found between the EA and considering sustainable design methods ($r = 0.185$; $p < .01$).

Practical non-significant relationships were found between the preservation scales and economy of resources ($r = .238$; $p < .01$), life-cycle design ($r = .147$; $p < .05$) and humane design ($r = .243$; $p < .01$). When comparing the utilisation scale, no practical significant relationships were found between the utilisation scales and economy of resources ($r = 0.033$; $p > .05$), life-cycle design ($r = 0.079$; $p > .05$) and humane design ($r = 0.102$; $p > .05$). Regarding the EA of the participants, practical non-significant relationships were also found between EA and economy of resources ($r = .186$; $p < .01$), life-cycle design ($r = 0.133$; $p > .05$) and humane design ($r = .214$; $p < .01$).

Table 4-7: Correlation of EA and sustainable design

Variable	EA	Preservation	Utilisation	Sustainable design methods	Economy	Life cycle	Human design
EA	1.000	.877**	.677**	.185**	.186**	0.133	.214**
Preservation	.877**	1.000	.287**	.227**	.238**	.147*	.243**
Utilisation	.677**	.287**	1.000	0.060	0.033	0.079	0.102
Sust. design methods	.185**	.227**	0.060	1.000	.890**	.871**	.822**
Economy	.186**	.238**	0.033	.890**	1.000	.762**	.632**
Life cycle	0.133	.147*	0.079	.871**	.762**	1.000	.595**
Humane design	.214**	.243**	0.102	.822**	.632**	.595**	1.000

* $p < .05$; ** $p < .01$

4.6 SUMMARY

This chapter has presented the quantitative data collected with statistical analysis thereof. The structure of the chapter was based on the layout of the three sections of the questionnaire (refer to Annexure B). This data will be used in discussion in Chapter 5. A summary of the results from this chapter are:

The total population group for this study ($N = 204$) consisted of 75.0% males and 25.0% with an average age of 41.71 years. Most of the participants were registered with SACAP as professional architects (93.1%) and 63.7% held a master's degree in architecture. More than three quarters of the participants acted as design architect (77.0%) on projects and 38.2% fulfilled the responsibilities of a principal architect on one to four projects. The participants were specialised in various architectural projects, such as residential (81.9%), commercial (64.7%) and governmental (35.8%).

Determination of the EA of the architects was through means of the revised shortened EAI-scale and the participants on average *partially agreed* with the scale items ($\bar{x} = 1.83$ out of 4; $s = 0.41$). The respondents also *partially agreed* with preservation scale statements ($\bar{x} = 1.76$ out of 4; $s = 0.47$) and with regards to the utilisation scale, the

participants on average *partially agreed* with the utilisation statements ($\bar{x} = 1.93$ out of 4; $s = 0.47$).

From the sustainable design method section of the questionnaire (refer to section 3 of annexure B), the data collected indicated that the participants did consider sustainability in the design. On average they *often* incorporated sustainable design methods into the design of architectural projects ($\bar{x} = 1.88$ out of 4; $s = 0.42$). The relationship between EA and considering sustainable design methods indicated that a practical non-significant relationship existed between the EA of the participants and considering sustainable design methods ($r = 0.185, p < .01$).

CHAPTER 5

RESEARCH CONCLUSIONS

5.1 INTRODUCTION

In chapter 4, the results obtained from the questionnaire were provided and briefly discussed. The focus of this chapter is to elaborate on chapter 4 by providing an in-depth interpretation of the results. The conclusion of this research study will be formulated in accordance with the research objectives set out in section 1.3. The limitations associated with the research study will also be provided, which will be followed by recommendations for future research studies.

5.2 OBJECTIVES OF THIS RESEARCH STUDY

The aim of this research study is to explore the EA of South African architects as a driving force for considering sustainable methods into the design of an architectural building and project. The following objectives were set out in chapter 1 (refer to section 1.3):

- i. Determine the environmental attitudes of the architects through applying the environmental attitudes inventory (EAI).
- ii. Determine the extent to which architects consider incorporating sustainable design methods into the designs of architectural buildings.
- iii. Establish the relationship that exists between EA and considering sustainable design methods.

5.3 DISCUSSION OF RESULTS

According to McIntyre and Milfont (2016:95) it is important to assess the EA of individuals as pro-environmental behaviour can be fostered. People are also more likely to perform certain behaviour if a positive attitude is held towards it. Based on the finding from this study the architects have concerned EA towards the natural environment ($\bar{x} = 1.83$ out of 4; $s = 0.41$). This entails the architects valuing the quality of the natural environment as important and consider it a priority to protect the environment from human alterations and harm (Milfont, 2007:188; Milfont & Duckitt, 2010:81,89).

As discussed in section 4.3.3, practical non-significant relationships were found between the EA of the participants and their age ($r = -0.042$; $p > .05$); the number of projects in which the participants are involved as principal architect ($r = -0.044$; $p > .05$); number of years of experience with an undergraduate qualification ($r = 0.020$; $p > .05$) and the number of years of experience with a postgraduate qualification ($r = -0.071$; $p > .05$). Therefore, none of these variables influence whether the participants had a concerned EA or unconcerned EA towards the natural environment.

Designing and constructing sustainable buildings are a mean through which negative environmental impacts, for example, pollution, waste generation, energy consumption, environmental impact of materials and construction processes, associated with the architecture industry can be minimised (Halliday, 2008:ix). Therefore, creating sustainable designs are considered as pro-environmental behaviour because the aim is to limit the negative or harmful impact on the environment and to create a built environment which is safe for the end-user to occupy (Loftness *et al.*, 2007:965; Ragheb *et al.*, 2016:778). The results from the sustainable design methods section of the questionnaire (as discussed in section 4.4.4) showed that the architects did incorporate sustainable design methods in the architectural projects ($\bar{x} = 1.88$ out of 4; $s = 0.42$).

Practical non-significant relationships were found between considering sustainable design methods and the age of the participants ($r = -.199$; $p < .01$); the number of

projects the participants were involved in as a principal architect ($r = -.154$; $p < .05$); number of years of experience with an undergraduate qualification ($r = -0.022$; $p > .05$) as well as number of years of experience with a postgraduate qualification ($r = -.156$; $p < .05$). Therefore, none of these above-mentioned variables influenced the participants' decisions to incorporate sustainable design methods in architectural projects.

Although the architects had a concerned EA towards the natural environment and did create sustainable designs, the results from the Spearman's correlation coefficient found a practical non-significant relationship between EA and considering sustainable design methods ($r = 0.185$, $p < .01$) (refer to section 4.5). Therefore, the concerned EA of the architects did not serve as a driving force for considering sustainable design methods. This finding contradicts the theory of Schafer and Tait (1986:3) that attitudes influence behaviour. Possible explanations could be that intervening factors inhibit and prevent the architects to create sustainable designs (Fishbein & Ajzen, 1975:218; Schafer & Tait, 1986:3).

Some of the respondents provided data that could be qualitatively analysed. Although this was not part of the original research methodology adopted for this study it is considered important to support, oppose or motivate the conclusions, as discussed in sections 5.4 and 5.7.

5.3.1 Qualitative results

A total of 5,358 questionnaires were sent out to architects in South Africa and 54 e-mails and six *Linkedin Messages* were received. Only a total of 12 ($N = 12$) respondents expressed substantially relevant opinions and practical experience related to practicing which could be used for this research study. Therefore, the response rate was calculated as 0.22%.

The content of the qualitative data content was analysed through means of thematic analysis (as previously explained in section 3.6.4.1). Six main themes were identified

which each embed various related subthemes. These themes are summarised in Table 5-1.

Table 5-1: Themes identified from the qualitative data

Theme and subthemes	Frequency (N)
Theme 1: Role of the architect	
Subtheme 1.1: Role and power of the architect is obscure	3
Subtheme 1.2: Dependent on developers	1
Subtheme 1.3: Persuade the client and other parties involved	3
Subtheme 1.4: Address stigma associated with sustainable designs	1
Theme 2: Role of the client	
Subtheme 2.1: Client drives decisions	4
Subtheme 2.2: Provides financial aid	3
Theme 3: Financial and cost implications	
Subtheme 3.1: Needs of the investors	1
Subtheme 3.2: Financial constrains	3
Theme 4: Sustainable designs go beyond environmental impact	1
Theme 5: Sustainable designs are regional context specific	1
Theme 6: Governmental role	
Subtheme 6.1: Sustainable building certification and protocols	1
Subtheme 6.2: Incentives and tax breaks for sustainable projects	1

These themes and subthemes will be discussed in the following sections.

5.3.1.1 Theme 1: Role of the architect

This theme illustrates that the role of architects does not signify that they are main decision-makers of an architectural project or building. Their designs are subject to the input, involvement, influence and perceptions of external parties. This resulted in the following four subthemes.

5.3.1.2 Subtheme 1.1: Role and power of the architect is obscure

Based on the feedback received from three respondents, the role and responsibilities of architect have been described as obscure, and there is a degree of influence architects have in a project is questionable. This is illustrated in the following three quotes:

Respondent #1: *“As I have come to notice the practice of architecture, and what an architect is, is very obscured in this day and age.”*

Respondent #5: *“In my opinion, I think you might have an inflated view of how much power/ influence architects have to effect the considerations dealt with in your questionnaire.”*

Respondent #11: *“A lot of the time in commercial/industrial projects (and some other projects), the architect has limited capacity to influence decisions about the environment.”*

5.3.1.2.1 Subtheme 1.2: Dependant on developers

It was mentioned that the architecture industry has grown dependent on the developers and that other parties influence the architectural process. One participant (respondent #3) reported on this subtheme, as illustrated by the following quote.

Respondent #3: *“I have come to realise how dependant our industry has become on developers.”*

5.3.1.2.2 Subtheme 1.3: Persuade the client and other parties involved

As commented upon by three participants (respondents #3, #8 and #12), the architect might be willing to incorporate sustainable methods into the building design, however, other parties involved hinder this process as they do not always value or understand the importance of sustainability. The following three quotes illustrate that the architect's role is to attempt to convince the client and to educate the contractors about sustainability.

Respondent #3: *“And sadly it has proven very difficult to educate these developers in the importance of sustainable design...”*

Respondent #8: *“...I'd suggest that the SA [South African] market (investors, stakeholders, developers, professionals) currently lacks the maturity for sustainable thinking ... but that is a strong and very personal opinion”.*

Respondent #12: *“I am really concerned and I am trying to convince clients regarding the application of building design while considering the environment.”*

5.3.1.2.3 Subtheme 1.4: Address stigma associated with sustainable designs

Based on feedback gained from one participant (respondent #3), the stigma associated with sustainable design influences the decisions and willingness to consider implementing sustainable methods:

“And sadly it has proven very difficult to educate these developers in the importance of sustainable design, since for many their [there] is a stigma attached to "sustainable design", they immediately see it as a long-term costly process. I do feel that we as architects have to look at how to change this stigma through providing a cost-effective yet sustainable design.”

5.3.1.3 Theme 2: Role of the client

This theme relates to the influence the client's decisions have on the design of the architect. The willingness of the client to implement sustainable methods determines the extent and type of sustainable element the architect incorporate into the designs. As the client is the main decision-maker and funder of the architectural building and project, the following two subthemes were established.

5.3.1.3.1 Subtheme 2.1: Clients drives decisions

It was mentioned by four participants (respondents #8, #9, #10 and #11) that the client drives the decisions regarding implementing sustainable methods into the design.

These decisions influence what the architect finally incorporates into the building designs. This is illustrated by the following three quotes:

Respondent #8 explained that for the architect to create a sustainable design he or she needs to be convinced: *“The bottom line can only be overcome once the client/developer has buy-in...”*

Respondent #9 mentioned the following:

“The client drives most of the decisions and typically follows the path of least resistance and maximum profit. So I could spend a lot of time designing the perfect environmentally sound building and just waste my time and fees because the client will simply tell me to change it. [...] I was a green design consultant for ten years and finally gave up on the whole notion of green commercial buildings. EVERYTHING is driven by the client and the QS, who are often extremely uninformed or simply don't care.”

Respondent #10 mentioned that architects did have a responsibility towards the environment, but they also had a responsibility towards the clients and meeting their needs. As a result, architects were sometimes confronted with making the decision of getting the project and disregarding the environment. The following quotation provides an explanation:

“Whilst it is our responsibility to be responsible to the environment, we also have a responsibility to the client. What that does is that it puts the most responsible Architects into dire financial straits, since those who are willing to do what the client requires regardless of harm to the environment - get the commission/job. [...] What this means is that if a client knows nothing of environmental or green considerations, the Architect who educates them on this is only going to make the client look for an Architect who will do what they say.”

5.3.1.3.2 Subtheme 2.2: Provides financial aid

Besides the client's decisions and willingness related to incorporating sustainable design methods, the client is also the funder for the building or project. The available budget influences whether certain sustainable methods will be allowed to be incorporated into the building design. Three participants (respondents #4, #7 and #9) reported on this subtheme, as illustrated by the following three quotes.

Respondent # 4 remarked that:

“The other large influencing factor is the clients, especially in residential, be it single or a development. They ultimately have the final say in their building because they are paying for it.”

Respondent #7 supported that the funder (which might be the client) of the architectural project influences the architect: *“I imagine architects are heavily influenced by those who are paying them”*.

Respondent # 9 expressed that the client’s decisions regarding sustainability is driven by *“maximum profit”*. If it will be expensive to incorporate sustainable design methods and the profit gain will be less, the client might reconsider sustainability. Therefore, clients do not necessarily prioritise the environmental impact of a building as a determining factor for considering sustainable design methods. Respondent #9 expressed the following: *“In seventeen years I have had one client who cared enough about the environment to build a truly green house.”*

5.3.1.4 Theme 3: Financial and cost implications

This theme alludes to financial benefits and incentives gained from implementing sustainable design methods which could serve as a motivational factor for designing and establishing sustainable buildings and projects. However, available funds and the costs associated with sustainable design methods influence the architectural design process. The following two subthemes provide an illustration.

5.3.1.4.1 Subtheme 3.1: Needs of the investors

The financial benefits and value assets associated with implementing sustainable design methods influence the extent to which architects incorporate sustainable design methods into the building designs. One participant (respondent #7) argued that if sustainability would lead to investments it might result in more buildings being sustainable:

"The largest listed property company Growthpoint (approximately hundred billion Rand in assets) have made ""greening"" their buildings a strategic priority. I think to a large extent capital drives decisions, commercial property has to meet investors' expectations so if sustainability supports a better investment then it will happen."

5.3.1.4.2 Subtheme 3.2: Financial constraints

The available funding influences the extent to which architects can incorporate sustainable design methods into the building design as well as which type of sustainable methods can be incorporated. It is apparent that the sustainable design methods are expensive, and the cost implication associated with considering and implementing sustainable alternatives influences whether it will be a viable option to implement. Four participants (respondents #3, #4, #8 and #9) referred to this subtheme, which is illustrated by the following four quotations.

Respondent #3 spoke of a stigma and perception about sustainable designs being expensive. This stigma resulted in resistance and hesitation to consider implementing sustainable design methods:

"...since for many their [there] is a stigma attached to "sustainable design", they immediately see it as a long-term costly process. I do feel that we as architects have to look at how to change this stigma through providing a cost-effective yet sustainable design. In South Africa I feel that low-tech design is probably the easiest way to accomplish this."

Respondent #4 stated that:

"If they decide they don't want to spend extra money on a fifty percent fly ash containing cement, or incorporating renewable energy technology, then they simply won't. This is a sad reality of this industry, but every now and then a great client comes along and does everything."

Respondent #8 provided the following statement:

"I recently went to tender for a small off grid home, utilising alternative construction methods, that we estimated should cost eight to nine thousand Rand per square metre, the tender prices came back at fifteen to twenty-five thousand Rand per square metre, and so that killed that idea very quickly."

Respondent #9 mentioned the following: *"The financial constraints on the project also often result in insufficient time to properly plan and integrate all requirements for sound design".*

5.3.1.5 Theme 4: Sustainable designs go beyond the environment

The theme illustrates that architects have the desire to implement sustainable design methods, not just because it is beneficial to the environment but, as mentioned by respondent #2 *“it helps humans connect with their environment.”*

5.3.1.6 Theme 5: Sustainable designs are regional context specific

With regards to incorporating sustainable methods into building designs it is important to consider the regional context of the specific project. Sustainable alternatives might be highly successful in one region but might not be a viable option in a different one, due to climatic conditions. One participant (respondent #6) provided the following explanation:

“...be aware that sustainable outcomes are partly achieved by an appropriate and careful response to a specific context. So, a solution that works really well in Pretoria, may not work nearly as well in Durban, due to climatic and other contexts/factors. A big part of sustainable design is in finding the right contextual response from a technical / material and component point of view, without necessarily relying on high-tech solutions like high performance glass for instance (we call it passive design). [...] What is "sustainable" in one place is not necessarily so in another. For example, composting toilets (waterless) do not perform well in high humidity areas, so they are not sustainable there.”

5.3.1.7 Theme 6: Governmental role

This theme focusses on the role the government has with regards to developing and enforcing laws which mandate a certain level of sustainable design as a standard practice. Along with legislation, green building rating systems have minimum requirements which must be met to obtain the lowest level of certification. The downfall is that it is not often that projects aim to obtain the highest level of certification. Perhaps if the minimum requirements were stricter, buildings might be more sustainable. This theme is illustrated by the following two subthemes.

5.3.1.7.1 Subtheme 6.1: Sustainable building certification and protocols

This subtheme illustrates that when the aim of implementing sustainable design methods is to gain certification with a green building rating system the architect might want to design an environmentally sustainable building. However, external parties might only require that the minimum requirements of the rating system are met. One participant (respondent #9) reported on this subtheme with the following quotation:

“Many of the major property companies target the minimum rating for buildings (which can hardly be considered very green) just to satisfy the board/stockholders”

In addition, respondent #9 also stresses the important role and influence the government has on mandating that certain or more sustainable methods must be part of the standard sustainable design. The strict requirements might lead to a change in the architecture industry. Respondent #9 provided the following explanation:

“Until the government mandates much stricter minimum green protocols and minimum fees for the professional team very little real change will be seen in the majority of commercial or industrial projects.”

5.3.1.7.2 Subtheme 6.2: Incentives and tax breaks for sustainable projects.

It might become more viable and preferable to design and construct an environmentally sustainable architectural building if the government would provide incentives, subsidies and tax breaks. One participant (respondent #9) reported on this sub-them and stated that: *“They also want to shore up the failing economy with tax instead of giving incentives and tax breaks for environmentally sound products/projects.”*

5.3.2 Interpretation of results

As concluded in section 5.3, the EA of the architects did not serve as a driving force for considering sustainable design methods. This finding that the participants' EA did not impact the performed pro-environmental behaviour (which in the context of this study is considered as considering sustainable design methods), could be ascribed to intervening factors.

Intervening factors prevent and inhibit an individual from performing certain pro-environmental behaviour, even though the individual holds a concerned environmental attitude towards the natural environment, environmental problems and the environmental quality (Fishbein & Ajzen, 1975:218; Schafer & Tait, 1986:3-4).

The following intervening factors influenced the behaviour of architects regarding incorporating sustainable design methods:

i. Knowledge

Knowledge and information that people consider to be true and factual related to environmental problems contribute towards acting responsibly with regards to the environment (Blake, 1999:210). Based on the qualitative feedback received from the architects (as discussed in section 5.3.1.1.3), it is clear that the knowledge of the contributing parties involved in an architectural project influences the design of the architect. The environmental knowledge influences the level of consciousness regarding environmental issues, which as a result leads to the prioritising of environmentally responsible behaviour. In the case of the architects, it was reported that they experienced a need to educate the involved parties about the importance of sustainable design. If the latter did not value sustainable designs as important it would inhibit the former from incorporating the sustainable design methods into the design.

ii. Economic incentives

According to Kollmuss and Agyeman (2002:246), receiving economic incentives when pro-environmental behaviour is performed motivates people to repeat it. It was mentioned that the current economic incentives and tax breaks from the South African government were not a strong motivational incentive for them to consider incorporating sustainable design methods (refer to section 5.3.1.6.2). Therefore, if the South African government was to provide viable tax breaks, incentives and subsidies for sustainable architectural projects and buildings, it might lead to the existence of more sustainable projects.

According to the World Green Building Council (2013:8), sustainable buildings are a greater asset and more marketable, thus tenants are attracted towards renting, purchasing and occupying sustainable buildings and certifying green ones. People are also willing to pay higher rental fees and purchasing prices for sustainable buildings. Besides higher asset value, higher occupancy rates and lower operating costs are positive outcomes of sustainable buildings (Afrifocus, 2014:9; World Green Building Council, 2013:8). Therefore, asset value, positive rental and occupancy rates as well as lower operating costs, serve as an economic incentive for considering sustainable designs. As highlighted by respondent #7 (refer to section 5.3.1.3.1), if the clients, stakeholders and investors recognise the economic benefits that can be gained from sustainable building they might be less resistant to the architects' sustainable designs. As a result, there might be more sustainable than conventional buildings being designed.

iii. Affect

Affect refers to the emotional reaction of architects towards environmental problems (Breckler, 1984:1191). Based on the data gathered from the EAI scale, three scales provided an indication of the architect's affect towards the natural environment (scale 7, 10 and 11).

The data obtained from scale 7 (previously discussed in section 4.3.2.3) of the shortened EAI-scale indicated that 75.9% of the architects prefer a wild and natural growing garden. This is an indication that the architects prefer that the natural condition of the environment be preserved. The architects further mentioned in scale 10 of the EAI (as discussed in section 4.3.2.5) that humans should not prioritise utilising nature for economic growth purposes. A total of 80.9% of the architects advocate that protecting the environment is a priority over job security. A total of 90.2% of the architects indicated that they became concerned when they saw the natural environment being destroyed. Therefore, it can be concluded that the architects were concerned about the environment and had compassion towards environmental harm.

The affect the architects had on the environment and its quality might play a role in their personal conservation behaviour (scale 8, discussed in section 4.3.1.5). Most of the architects (91.2%) indicated that they tried to conserve the environment through performing pro-environmental behaviour and activities. However, when it came to the sustainable designs it was apparent that the effect on the architects was unimportant. Even though the architects were willing to incorporate sustainable design methods the effect of the involving parties would influence whether the architects incorporated sustainable design methods into the final building design. It was mentioned that the other parties involved in the architectural process did not care or value sustainability and the environment (refer to section 4.6.2.1).

In addition, life-cycle design is concerned with the environmental impact a building and building processes has on the environment (Jong-Jin & Rigdon, 1998:8). On average ($\bar{x} = 2.15$; $s = 0.57$), the architects indicated that they *often* considered the life-cycle design methods during the design process (as discussed in section 4.4.2). The relationship between EA and life-cycle design was calculated and a practical non-significant relationship ($r = 0.133$; $p > .05$) was found (as discussed in section 4.5). Thus, the emotional connection and reaction that the architects have towards protecting and preserving the environment had no relationship with considering life-cycle designs.

iv. Self-efficiency and responsibility

According to Ajzen and Fishbein (2005:193), self-efficiency relates to the architects' belief they have the necessary skills and ability to perform a certain pro-environmental behaviour, for example, creating sustainable designs. The greater sense of control the architects experienced over certain behaviour the more likely it would be to perform the behavioural act (Ajzen, 1991:182-183; Greaves *et al.*, 2013:110).

On average, the architects *often* incorporated sustainable design methods into the architectural designs ($\bar{x} = 1.88$; $s = 0.42$), therefore, it can be considered that they did not doubt their ability, resources or past experiences to create

sustainable designs (Ajzen, 1991:196). However, the opposite was noted in the qualitative feedback received as it was mentioned that the role architects fulfilled in a project was obscure (refer to section 5.3.1.1.1). The architects were also dependent on the input and decisions of other disciplines and role players (refer to section 5.3.1.1.2 and section 5.3.1.2.1). As a result, they believed they had limited power and control over decisions related to the environment and fully incorporating sustainable design methods. Therefore, these abovementioned intervening factors create obstacles for the architects to experience a sense of control over the behaviour of creating sustainable designs (Ajzen, 1991:182-183; Greaves *et al.*, 2013:110).

Another intervening factor which influenced the architects' perception of whether it was possible to create a sustainable design was that certain sustainable design methods were specific to regions (refer to section 5.3.1.5) and that sustainable design methods and technologies were expensive (refer to section 5.3.1.3.2). If the obstacle of an expensive sustainable solution could be resolved by finding alternative cost-effective sustainable solutions the architects could experience a sense of control over the sustainable design (Ajzen, 1991:182-183; Greaves *et al.*, 2013:110).

v. Reinforcing feedback

The design that the architects create is their artistic expression and if they are satisfied with the design a feeling of accomplishment and pride is experienced (McLennan, 2004:226). When the architect presents the design to the client, funders and stakeholders, and they reject or change it, the architect can be discouraged and disappointed.

Respondent #11 mentioned:

“So, I could spend a lot of time designing the perfect environmentally sound building and just waste my time and fees because the client will simply tell me to change it... I was a green design consultant for ten years and finally gave up on the whole notion of green commercial buildings.”

The contrary is also true, because when an architect designs a sustainable building which is approved by the client, a sense of pride and satisfaction is

experienced that the environmentally responsible deed was committed. As mentioned by participant #11: “In seventeen years I have had one client who cared enough about the environment to build a truly green house.”

5.4 RESEARCH CONCLUSION

With regards to the research objectives set out in section 1.3, for this research study the following conclusions could be drawn related to the objectives:

i. Determine the environmental attitudes of the architects through applying the environmental attitudes inventory (EAI).

The quantitative results obtained from the shortened EAI-scale showed that the architects had a concerned EA towards the natural environment ($\bar{x} = 1.83$ out of 4; $s = 0.41$). Therefore, the architects considered it important to preserve the quality of the natural environment and valued protecting the environment from harm, human utilisation and alterations (Milfont, 2007:188; Milfont & Duckitt, 2010:81,89).

ii. Determine the extent to which architects consider incorporating sustainable design methods into the designs of architectural buildings.

The results of this study found that the architects *often* considered incorporating sustainable design methods in the architectural building designs (refer to section 4.4.4). Therefore, they did consider sustainable building designs through incorporating sustainable design methods.

iii. Establish the relationship that exists between EA and considering sustainable design methods.

The results indicated that the concerned EA of the architects had no practical significant relationship with considering sustainable design methods (refer to section 4.5).

This research study concludes that the concerned EA of architects did not influence the sustainable design methods considered when designing an architectural building

or project in South Africa. Therefore, the concerned EA of an architect did not serve as a driving force for considering sustainable design methods due to external intervening factors (such as the environmental knowledge, decision and affect towards the environment of the client and other involving parties, available funding, governmental incentives) which influences the decisions that architects make with regards to incorporating sustainable design methods.

5.5 LIMITATIONS OF THIS RESEARCH STUDY

In this research study the EA of actively practicing South African architects, registered with SACAP, were determined as well as the extent to which they consider sustainable design methods. However, certain limitations were encountered:

- i. The exact number of questionnaires distributed by SAIA could not be verified, but SAIA stated that an estimation of 500 was sent out. This influences the sample size and response rate used for this study.
- ii. A convenient sample was used so only participants who had an active *LinkedIn* account and/or e-mail address could participate in the study. As a result, some participants who did not have an active *LinkedIn* account and/or e-mail address were excluded from the sample size. As SACAP only distributed the questionnaire to all the professional architects registered on their database the professional senior architectural technologists were excluded. As a result, the professional senior architectural technologists might be under-presented in this study. In addition, the criteria of distributing the questionnaire to professional architects would be described as a purposive sample.
- iii. Reminder e-mails were sent out to the participants by SAIA and the researcher. However, it was not possible for SACAP to send a reminder e-mail due to limited time, thus, some participants could have received the questionnaire and were willing to participate in the research but forgot. In addition, reminder e-mails could also cause the participants to resist complete the questionnaire.

5.6 RECOMMENDATIONS FOR FUTURE RESEARCH OPPORTUNITIES

The following suggestions could be considered for future research studies:

- i. A further research study could adopt a qualitative research approach and conduct structured interviews with architects to gain an in-depth understanding regarding the intervening factors the architects consider to be influencing their design decisions and possible solutions to address these intervening factors.
- ii. Future research studies are required to explore the EA of clients, contractors, developers and/or other parties involved in architecture projects. One of the comments received by three participants (respondents #4, #5 and #8) suggested that the questionnaire be directed towards the developers, quantity surveyors, contractors, and fund managers, but especially the client. This is illustrated by the following two quotations:
- iii. Respondent #4 mentioned the following: “Is this questionnaire specifically aimed at architects or have you created separate ones for different disciplines as well as contractors?”
- iv. Respondent #8 stated that: “I think maybe your premise is misdirected. Shouldn’t you be asking whether the client/developers are prepared to consider sustainable designs?”
- v. Another future research study could involve the EA of architects or other involving parties being explored within a specific sector, such as residential, commercial or corporate. Respondent #5 suggested the following: “*I think it is more a question for developers / fund managers etcetera in the corporate and commercial sectors.*”
- vi. This research study could also be repeated while adopting a cross-cultural comparative research methodology. The study could compare the EA of architects practicing in various countries and the extent to which the architects consider sustainable designs methods.

5.7 CONCLUSION

The aim of the study was to determine whether the EA of architects practicing in South Africa influences the sustainable design methods considered in the architectural designs. The literature study indicated that the EA of an individual could impact the pro-environmental behaviour performed (creating sustainable designs). However, this study revealed that the EA of actively practicing South African architects did not serve as a driving force for considering sustainable designs due to intervening factors.

Although architects are the main creators of architectural designs, intervening parties involved in architectural projects influence the type and extent to which they incorporate sustainable design methods into the final architectural design. Furthermore, the architects have the abilities, skills, knowledge and willingness to create sustainable designs, but the decisions and influence of the decision-makers and other involved parties inhibit their sustainable designs. Therefore, it is crucial that decision-makers value and trust the knowledge of the architects and provide them with the opportunity to make design decisions that are beneficial to the natural and built environment. These finding could be further explored in future by conducting an in-depth study into the intervening factors and how they can be addressed.

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ANNEXURE A
COVERING LETTER



NORTH-WEST UNIVERSITY
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Study leaders:

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Prof. F.P. Retief
Tel: 018 299 1586
E-mail: francois.retief@nwu.ac.za

25 May 2017

Best Architect

Research Topic:

Environmental attitudes of architects as a driving force for considering sustainable designs.

My name is Nicolette Tolsma, and I am currently completing my Masters in Environmental Management at the North-West University. As part of my dissertation, I am exploring the environmental attitudes of South African architects as a driving force for considering sustainable designs.

As a SACAP registered architect actively practicing in the industry, your cooperation and participation in this research survey will provide valuable insights. Please refer to the following link to access the survey <https://goo.gl/forms/neuqnbIpFkn8fMby1>.

The questionnaire consists of three sections which will take approximately **15 minutes** in total to complete. If you choose to participate in this research project, please answer all the questions honestly and submit the completed questionnaire by **21 July 2017**. Please ensure that you click the "submit" option once completed. The data and information collected will be confidential and if you are interested a copy of the final findings can be sent to you upon your request. Participation is voluntary and you may refuse to participate at any time.

If you require any additional information or have any queries, or have difficulty accessing the link, please do not hesitate to contact me.

Once again, thank you in advance for offering your valuable time and input, it is truly appreciated.

Yours sincerely,

Ms. Nicolette Tolsma
Masters Student
E-mail: nicolette.tolsma@gmail.com

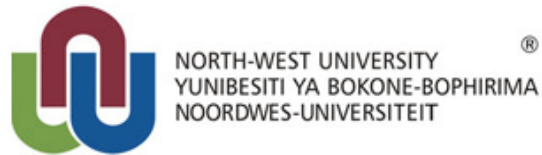
ANNEXURE B
QUESTIONNAIRE

Environmental Attitudes of architects as a driving force for considering sustainable designs.

The aim of this study is to explore the Environmental Attitudes of South African architects as a driving force for considering sustainable designs.

As an SACAP registered architect practicing in the industry your voluntary cooperation and participation in this research survey will provide valuable insights. The data and information collected will be confidential.

* Required



Section 1: Individual background information



1.1 Gender

Please indicate your gender:

Mark only one oval.

- ☐ Male
☐ Female

1.2 Age

Please state your age:

1.3 Qualification

Please indicate your highest level of qualification obtained:

Mark only one oval.

- ☐ National Senior certificate
☐ National diploma
☐ Bachelor's degree
☐ Postgraduate / Honours degree
☐ Master's degree
☐ Doctoral degree
☐ Other: _____

1.4 Professional Registration Category *

Please indicate your category of professional registration with SACAP:

Mark only one oval.

- ☐ Professional Architect
☐ Professional Senior Architectural Technologist
☐ Professional Architectural Technologist
☐ Professional Draughtsperson
☐ Candidate Architect
☐ Candidate Senior Architectural Technologist
☐ Candidate Architectural Technologist
☐ Candidate Architectural Draughtsperson
☐ Other: _____

1.5 Primary field of professional activity *

Please indicate which professional activity suits your daily tasks best:

Mark only one oval.

- ☐ Design architect
☐ Construction architect
☐ Project architect
☐ Site architect
☐ All of the above
☐ Other: _____

1.6 Over the past five years, how many projects have you been assigned the responsibility of principal architect? *

Indicate the number of projects you were involved in as the principal architect:
Mark only one oval.

- ☐ None
- ☐ 1 - 4
- ☐ 5 - 9
- ☐ 10 - 14
- ☐ 15 or more

1.7 Years of experience as an architect with an undergraduate qualification

Please state the number of years of experience you have as an architect with an undergraduate qualification:

1.8 Years of experience as an architect with a postgraduate qualification

Please state the number of years of experience you have as an architect with a postgraduate qualification:

1.9 Field of architectural expertise *

Please indicate on which type of projects you have spend most of your time on:
Check all that apply.

- ☐ Commercial projects
- ☐ Governmental projects
- ☐ Healthcare
- ☐ High rise buildings
- ☐ Hotel and leisure projects
- ☐ Residential projects
- ☐ Other: _____

Section 2: Environmental Attitude Inventory Scale.

Milfont, T.L. & Duckitt, J. 2010. The environmental attitudes inventory: A valid and reliable measure to assess the structure of environmental attitudes. *Journal of environmental psychology*, 30(1):80-94.



Instructions

You will be presented with various statements about the relationship between humans and the environment. For each one, please indicate to what extent you agree or disagree with each statement.

1 = Strongly agree; 2 = Partially agree; 3 = Partially disagree; 4 = Strongly disagree

Mark only one oval per row.

	1	2	3	4
2.1 I like going on trips into the countryside, for example to the bushveld or nature reserves.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2.2 I enjoy spending time in nature.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2.3 Governments should control the rate at which raw materials are used to ensure that they last as long as possible.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2.4 I would like to join and actively participate in an environmentalist group.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2.5 One of the most important reasons to keep dams and rivers clean is so that people have a place to enjoy water sports.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2.6 We need to keep dams and rivers clean in order to protect the environment.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2.7 Modern science will solve our environmental problems.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2.8 Humans are severely abusing the environment.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2.9 I'd prefer a garden that is wild and natural to a well groomed and ordered one.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2.10 Wherever possible, I try to save natural resources.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2.11 Human beings were created or evolved to dominate the rest of nature.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2.12 Protecting peoples' jobs is more important than protecting the environment.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2.13 It makes me sad to see natural environments cleared for agriculture.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2.14 It makes me sad to see natural environments destroyed.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2.15 Families should be encouraged to limit themselves to two children or less.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2.16 People should have as many children as they wish, as long as they can adequately provide for them.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Section 3: Sustainable Design Methods

Part 1



3.1 Economy of Resources

Jong-Jin, K. & Rigdon, B. 1998. Sustainable architecture module: Introduction to sustainable design. Ann Arbor, MI: National Pollution Prevention Center for Higher Education.

Instructions

You will be presented with various statements regarding sustainable practices that could be considered during the design stage. For each one, please indicate to what extent these practices are considered.

1 = Always; 2 = Often; 3 = Seldom; 4 = Never; N/A = Not Applicable

Mark only one oval per row.

	1	2	3	4	N/A
3.1.1 During the spatial planning process, I consider accessibility to public transportation services or facilities to reduce pollution associated with transportation.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.1.2 I take the orientation of a building into consideration when designing to reduce energy consumption during the operational phase.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.1.3 I consider passive solar energy in my designs.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.1.4 In my designs, I incorporate on-site energy generation systems through renewable energy systems.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.1.5 I incorporate high-performance windows to prevent heat gain or heat loss.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.1.6 I integrate wall insulation practices to prevent heat gain or heat loss.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.1.7 I incorporate materials with insulation properties to prevent heat gain or heat loss.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.1.8 I optimise utilisation of natural daylight.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.1.9 During the design process I take operational cost into account.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.1.10 My designs integrate the utilisation of energy efficient appliances to reduce operational cost.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

3.1.11 I utilise construction materials with low embodied energy.

☐☐☐☐☐

3.1.12 I implement on-site greywater recycling practices.

☐☐☐☐☐

3.1.13 I incorporate rainwater harvesting techniques for on-site storage and usage (on-site irrigation or flushing of toilets).

☐☐☐☐☐

3.1.14 I incorporate low flow devices such as low flow shower heads/taps; dual flush toilets and waterless urinals systems.

☐☐☐☐☐

3.1.15 I incorporate sewage water recycling practices.

☐☐☐☐☐

3.1.16 I make provision for stormwater collection practices.

☐☐☐☐☐

3.1.17 Refurbish an existing building instead of constructing a new one.

☐☐☐☐☐

3.1.18 I utilise recycled construction materials for the construction of a new building.

☐☐☐☐☐

3.1.19 I utilise construction materials and products that can be recycled again.

☐☐☐☐☐

3.1.20 I make provision for the availability of on-site recycling facilities or bins.

☐☐☐☐☐

Section 3: Sustainable Design Methods

Part 2



3.2 Life-cycle design

Jong-Jin, K. & Rigdon, B. 1998. Sustainable architecture module: Introduction to sustainable design. Ann Arbor, MI: National Pollution Prevention Center for Higher Education.

Instructions

You will be presented with various statements regarding sustainable practices that could be considered during the design stage. For each one, please indicate to what extent these practices are considered.

1 = Always; 2 = Often; 3 = Seldom; 4 = Never; N/A = Not Applicable

Mark only one oval per row.

	1	2	3	4	N/A
3.2.1 I take the environmental impact of construction materials into consideration.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.2.2 I utilise materials that are made from recycled materials.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.2.3 I often verify the suppliers' processes.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.2.4 I take into consideration the life-cycle of materials and products.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.2.5 During construction, I consider how harm to the environment and ecosystem can be avoided.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.2.6 I consider utilising materials which do not contain ozone depleting substances.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.2.7 I utilise non-toxic materials and substances.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.2.8 I consider the redevelopment of existing buildings and infrastructure to avoid construction in undisturbed areas.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Section 3: Sustainable Design Methods

Part 3



3.3 Humane design

Jong-Jin, K. & Rigdon, B. 1998. Sustainable architecture module: Introduction to sustainable design. Ann Arbor, MI: National Pollution Prevention Center for Higher Education.

Instructions

You will be presented with various statements regarding sustainable practices that could be considered during the design stage. For each one, please indicate to what extent these practices are considered.

1 = Always; 2 = Often; 3 = Seldom; 4 = Never; N/A = Not Applicable

Mark only one oval per row.

	1	2	3	4	N/A
3.3.1 I conduct a detailed site analysis to consider the site characteristics in the design.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.3.2 When designing, I take into account the depth of the water table.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.3.3 I value it as a priority to rehabilitate the natural environment and habitats after construction.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.3.4 I value protecting existing vegetation and habits during construction.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.3.5 I incorporate existing vegetation and habitats into the design.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.3.6 I create a common green area, recreation area or public open space in each plot area.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.3.7 I incorporate a playground in each plot area.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.3.8 I make provision for sidewalks and cycling paths.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.3.9 To encourage car sharing, I create parking for the sole use of priority vehicles.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.3.10 I incorporate various land uses such as markets, shops, retail centers, healthcare facilities, residential, commercial, office and retail space.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.3.11 I utilise windows to create a visual connection to the external environment.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.3.12 I incorporate end-user control to regulate indoor temperature and natural ventilation.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.3.13 In my designs I consider the needs of the end-user.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.3.14 I take the needs of various age groups into consideration when designing.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.3.15 My designs accommodate physical conditions/disabilities.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

ANNEXURE C
ACKNOWLEDGEMENT OF LANGUAGE EDITING

Acknowledgment of Language Editing

Date: Saturday, 18 November 2017

This is to certify that I have conducted Language Editing on a Master's
Dissertation:

*Environmental attitudes of architects as a driving force for considering
sustainable designs*

by

N Tolsma

Algraham

Andrew Graham (BA, MA dist., PhD, University of Keele, UK)*



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