Determining the barriers to the uptake of environmentally friendly technologies – the case study of electronic signatures

L Smit

25398040

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Supervisor: Ms CS Steenkamp

Co-Supervisor: Dr J Pope

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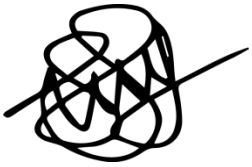
DECLARATION

By submitting this dissertation electronically, I declare that the entirety of the work contained herewith is my own, original work, that I am the authorship owner thereof (unless to the extent explicitly otherwise stated) and that I have not previously in its entirety or in part submitted it for obtaining any qualification.



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ABSTRACT

Keywords: electronic signatures; environmentally friendly; waste management; paper waste; ECT Act; environmental management.

For centuries people have been using paper and have relied on printing documents for purposes of signing it. Despite the advent of new technologies allowing for electronic signing, the conversion to electronic signing has been met with some reluctance. People continue to use paper daily to sign documents, without taking cognisance of the effect their consumption of paper has on the environment. Considered one of the world's most polluting industries, the pulp and paper industry is a major contributor to air, water and soil pollution.

The National Waste Management Strategy not only endorses, but strongly encourages the minimisation of waste. The thought process behind the minimisation of waste, manifests itself firmly in the suggestion of electronic signatures instead of manuscript signatures. Electronic signatures and electronic documents are permitted and valid in South Africa, therefore allowing for the conversion from paper to digital without having to acquire additional devices. The definition of an electronic signature is wide and encompasses a number of concepts relevant to the technology utilised that links a person whose intention it is to sign, to the electronic document signed. Although legislation and technology is available to support electronic signatures, there are several organisations which are insistent on manuscript signatures. The research aim was to determine what the barriers are to the uptake of environmentally friendly technologies, with a specific focus on electronic signatures. The research design followed the approach of an exploratory study, which enabled the author to explore the abovementioned barriers. The research methodology utilised in the approach to gather information and conduct research, was qualitative and was aimed at gaining insight into the attitudes of senior personnel within South African companies. The author utilised an online questionnaire and interviews as mechanisms to gather information from both

consumers in various companies from a wide range of industries as well as the service providers from companies offering electronic signatures solutions.

In this study it has emerged that the majority of the leading barriers relating to environmentally friendly technologies are ascribed to attitude, such as the lack of awareness, uncertainty, fear, personal barriers, security concerns, loss of control, lack of trust and poor decision-making, as well as to facilitators, which refer to elements such as inadequate regulatory framework, lack of governmental support, lack of incentives, lack of skilled workers, high costs or lack of funding and lack of available information. In order to initiate a change in behaviour, awareness within society needs to be addressed in order to increase the level of knowledge. To overcome the lack of knowledge, several studies recommended that effective communication can improve the introduction and implementation of environmentally friendly technologies, whether it's between government and the community, investors and the public or implementers and consumers. In order to create a mind-shift within society and encourage wide implementation, the amendment of certain legislation to support electronic signing as well as internal policies and encouragement from management will be necessary.

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Last, but not least, to Chantal Sebastiaõ, for creating and managing the online questionnaire to ensure impartiality and accuracy, as well as for reviewing the language in this study. Furthermore, my gratitude for your unconditional support, consideration and sacrifices extends beyond words. Thank you for continuously encouraging me, for having faith in me and for all those big and small things that made my life easier and this research possible.

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ABBREVIATIONS

AES	Advanced Electronic Signature/s
ECT Act	Electronic Communications and Transactions Act 25 of 2002
GCC	Gulf Cooperation Council
NEMA	National Environmental Management Act 107 of 1998
NEM:WA	National Environmental Management: Waste Act 59 of 2008
NWMS	National Waste Management Strategy
PKI	Public Key Infrastructure
UAE	United Arab Emirates
US	United States of America

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CHAPTER 1: INTRODUCTION AND PROBLEM STATEMENT

…"earth does not have an infinite capacity to absorb waste" (King, 2015)

1.1 BACKGROUND

For centuries, there has been a reliance on manuscript signatures (ink-based or wet signatures applied to paper) to conclude agreements, seal documents and add the element of trust to a certain extent between contracting parties. As time passed, several technological advancements have been made to simplify life, streamline contractual negotiations and conclusions, as well as to minimise the impact on the environment. One of these technological advancements, presents itself in a simple form that is already used in emails and electronic documents – electronic signatures. An electronic signature is defined as "*data attached to, incorporated in, or logically associated with other data and which is intended by the user to serve as a signature*" (South Africa, 2002:section 1). In practice, three different types of signatures are utilised; electronic signatures, digital signatures and advanced electronic signatures. These types of signatures will be explained further in Chapter 3 of this study.

The utilisation of electronic signatures, is not a new phenomenon and has been in practice internationally and specifically in South Africa, for over a decade. The Electronic Communications and Transactions Act (ECT Act) (South Africa, 2002) defines, legalizes and regulates electronic signatures, as well as electronic documents in South Africa. Several companies, governmental departments and organisations have implemented electronic signatures to sign off documents and replace paper-based operations. The technology for creating digital signatures is available and has proven to be trusted by not only private companies such as banks, but also governmental organisations such as the Department of Home Affairs, with the roll-out of the national identity cards. In the same breath, several companies are hesitant to use electronic signatures and still utilise manuscript signatures on documents. This statement sprouts from requests received by the author from governmental organisations as well as private companies, for documents to be printed and signed in duplicate, before the

commencement of a project. With the majority of documents originating in digital form, it makes sense for it to remain in digital form and utilise electronic signatures to formalise the conclusion or approval, instead of having to print documents and apply manuscript signatures to it.

Research reflects that nearly half of the documents that are printed by legal professionals, are for the sole purpose of adding a manuscript signature to the document (Belkin, 2014). An astounding number of trees would need to be cut down for pulp and paper production for merely 50% of these documents. In order to produce one ton of non-recycled printing and office paper, twenty four trees need to be cut down (Anon. 2014b). Considered one of the world's most polluting industries (Thompson *et al.*, 2001; Sumathi & Hung, 2006; Ince *et al*., 2011, Petraru *et al*., 2011), the pulp and paper industry is responsible for air, water and soil pollution (Ince *et al*., 2011). Substantial solid wastes, such as *"green liquor dregs, lime mud, lime slaker grits, boiler and furnace ash, scrubber sludges, wood processing remains and wastewater treatment sludges"* are produced from several mills (Ince *et al*., 2011:223). Numerous environmental concerns originate from the disposal of these solid wastes (Monte *et al*., 2009). The majority of the air emissions resulting from the pulp and paper industry, originate from sulfite mills, kraft operation and combustion processes (Smook, 1992). Some of these harmful emitters, are nitrogen oxide, ketone, alcohol, carbon disulfide methanol, acetone and chloroform, as pointed out by Smook (1992). The pulp and paper production industry not only pollutes in the physical sense, but also utilises high volumes of water, especially fresh water, and demands a large amount of energy (Pokhrel & Viraraghavan, 2004). Due to the fact that the pulp and paper industry is a large consumer of electricity, the unpredictable electricity production in South Africa will pose an enormous challenge[1]. In an age where everything else is digitalised, it is difficult to comprehend why there is still an insistence on paper, if the paper production industry has such a severe impact on the environment.

Section 24 of the Constitution (South Africa, 1996), provides not only the right to a clean and healthy environment, but also places a responsibility on people to treat the environment in a sustainable manner and to ensure a clean and healthy environment for

[1] South Africa's energy supply is a cumbersome issue which has been discussed extensively in the news during 2014 and 2015. Recent black-outs (load shedding) have resulted in many industries losing millions as a result of no electricity.

future generations. The National Environmental Management Act (South Africa, 1998) was promulgated to give effect to section 24 of the Constitution and to conserve the environment, which translates into people having to conduct themselves and carry out activities in a sustainable manner.

Already in the 1950's, Barzun (1959) was quoted saying *"If civilization has risen from the Stone Age, it can rise again from the Wastepaper Age".* Fifty six years later, it would still appear that paper is used without appreciation or consideration for the impact it may have on the environment. This statement is substantiated by Weber (2014), who is of the opinion that a general document is copied five times. Some may argue that paper can be recycled and in the process, reduce the negative environmental impacts associated with the use of paper. This statement is not entirely accurate. According to Bauer (2011), *"recycling paper saves energy, reduces pollution, preserves trees and conserves landfill space, but it is a messy process"* which utilises hazardous chemicals during the recycling process and also results in harmful by-products and air emissions. Bauer (2011) proceeds to state that even the production of plastic is more energy efficient than recycling paper. The argument in favour of paper production as a result of possible recycling is met with several disadvantages that severely impact our environment. Therefore, moving beyond the recycling (which appears to remain harmful to the environment) towards reducing waste, would seem like the optimal choice (Bauer, 2011). This is reiterated in the National Waste Management Strategy (NWMS) (DEA, 2011), as prescribed by the National Environmental Management: Waste Act (South Africa, 2008a), which highlights the following objectives that form the core of the NWMS:

- Encourage the minimisation of waste and promote the *"re-use, recycling and recovery of waste"*;
- Improve waste management service delivery;
- Utilise the waste industry to positively influence and encourage a green economy;
- Increase public awareness on the harmful effect of waste;
- Work towards a co-operative waste management strategy;
- Effectively plan financially to ensure successful waste management;
- Offer instruments that assist in the rehabilitation of polluted land;
- Ensure compliance with NEM:WA, which will include enforcement of laws.

The figure below is an expression of the priorities set by the NWMS, in order to attain its 2016 targets of diverting 25% of "*recyclables from landfill sites for re-use, recycling or recovery*" (DEA, 2011:6) and reduce waste in the paper and packaging industry (DEA, 2011). The top priority is to reduce and avoid waste. Once waste cannot be avoided or reduced, the re-using, recycling and recovery should be considered. If all of the options have been exhausted, waste should then as a last resort be treated or disposed of.

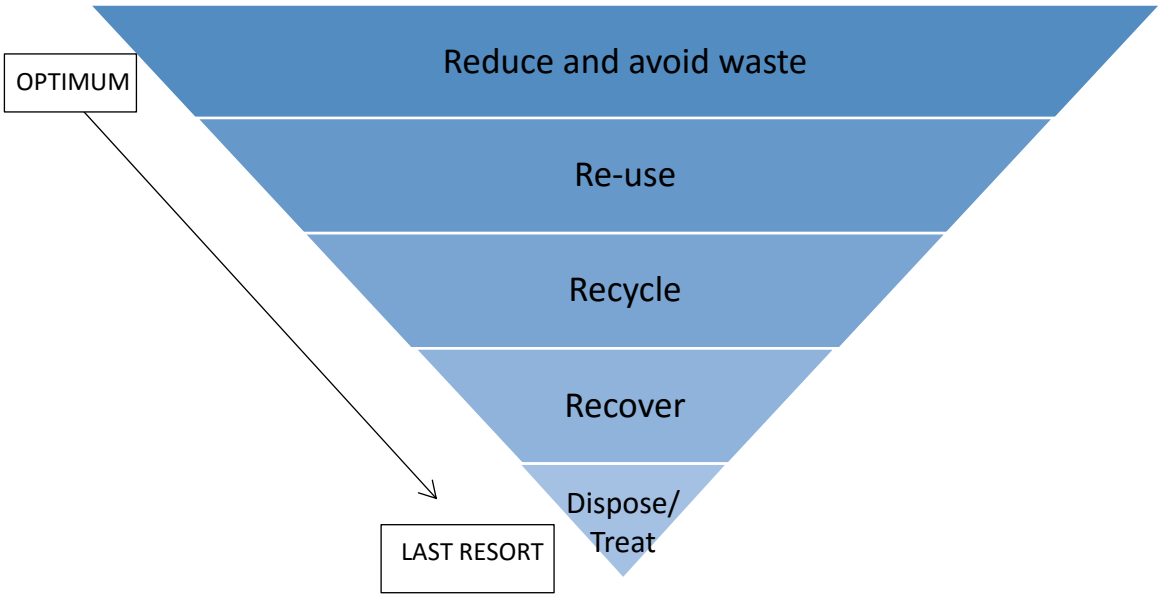


Figure 1: Adaptation of Waste Management Hierarchy (DEA, 2011)

In the 21st century, due to a high demand, large quantities of paper are still produced, resulting in an increase of paper waste, contrary to the goals of the NWMS. An expert on corporate governance in South Africa, Professor Mervyn King, made a very important statement, "*earth does not have an infinite capacity to absorb waste*" (King, 2015). This stems from the belief that people assume that earth can perpetually absorb waste and renew resources, despite the manner in which humankind conducts itself. The thought process behind the minimisation of waste, manifests itself firmly in the suggestion of applying electronic signatures instead of manuscript signatures to documents. To elaborate on the minimisation, it has to be made clear that in order to utilise electronic signatures, no additional electronic devices are required. Statistics show that 97% of the adult South African population, can be reached via cellphone and 36% own a smartphone (Buckle, 2014), therefore the basic infrastructure is already in

place. The author's hypothesis is that a general misunderstanding and lack of awareness of electronic signatures exist, which have an impact on the level of uptake of electronic signatures amongst companies.

1.2 PROBLEM STATEMENT

Although South Africa has legislation (South Africa, 2002; South Africa, 2008a) supporting electronic signatures and the technology to create, store and support such electronic signatures and electronic documents, the author's experience is that some companies still request manuscript signatures on documents and more often than not, several copies are made to sign. In the absence of research literature delving into electronic signatures and its application, the general understanding of electronic signatures is very misconstrued. The generation of paper has significant environmental impacts. This paper aims to identify the barriers that prevent companies from fully implementing electronic signatures and switch from using manuscript signatures, and perhaps in the process, identify opportunities that can be explored in future.

1.3 RESEARCH QUESTION AND SUB-RESEARCH QUESTIONS

The research aim of this paper is to address what the barriers are that prevent companies from fully implementing electronic signatures.

Two research questions have been identified in support of attaining the research aim:

1. Are companies familiar with the ECT Act enabling electronic documents and electronic signatures to be used and is this a factor in the decision to implement electronic signatures? The objective is to establish whether awareness creates a challenge to the uptake of electronic signatures.

2. What barriers to the implementation of environmentally friendly technologies have been identified in the literature and which of these barriers are impeding the implementation of electronic signatures in South Africa? The objective is to utilise

the barriers identified in other environmentally friendly technologies as a starting point and establish whether similar barriers exist with electronic signatures.

The Below is a brief outline of what will be addressed in the remaining chapters.

Chapter 2: Relying on the data produced in this study

This chapter focuses on the research methodology, research design and research methods as well as addresses the trustworthiness of the study.

Chapter 3: An introduction to electronic signatures in South Africa

This chapter provides insight and detail into what electronic signatures are.

Chapter 4: Environmentally friendly technologies and the barriers to implementation

This chapter is the first chapter that forms part of the literature review and explores other environmentally friendly technologies and the barriers and challenges experienced by those. This chapter addresses the first portion of the second research question.

Chapter 5: Barriers to the uptake of electronic signatures

This chapter discusses and analyses the results from the questionnaires and interviews as well as discuss and compare the barriers identified in Chapter 4. This chapter addresses the research aim, the first research question as well as the second portion of the second research question.

Chapter 6: Conclusion and Recommendations

This chapter concludes the findings in the research and presents recommendations.

CHAPTER 2: RELYING ON THE DATA PRODUCED IN THIS STUDY

2.1 RESEARCH DESIGN & RESEARCH METHODOLOGY

Research is defined as *"the systematic investigation into and study of materials and sources in order to establish facts or verify information"* (South African Concise Oxford Dictionary, 2002:993). Research forms the basis of any study in order to obtain information and generate results. The following paragraphs will elucidate the research approach and information processing.

The research design was developed based on the structure of the research aim, as well as the research questions. The research design follows the approach of an exploratory study (Van Wyk, 2009), which will enable the author to explore which barriers prevent companies from fully implementing electronic signatures. Exploratory research relates to the creation of a hypothesis, as the author does not have an answer to the possible results of the research (Sahu, 2013). The reason for this research design method, is to gain an understanding of the 'what' factor and in doing that, explore human behaviour to some extent.

The research methodology utilised in the approach to gather information and conduct research, is qualitative, as it aims to gain insight into the attitudes of people (Sahu, 2013). "*Qualitative research is often referred to as 'real world' research*" as it ordinarily consists of observations as well as interactive techniques such as interviews and questionnaires (Endacott 2008:48).

The author intends to gain a clear understanding of the reason behind the hesitation to implement environmentally friendly technologies. The barriers identified will be investigated and explored as part of this research, to answer the research questions as well as to determine if any or all of the barriers listed as part of the literature review are experienced by any of the participants to this research and relevant to this study.

The author utilised a literature review, an online questionnaire as well as interviews to gather information. The data from the questionnaires and interviews was compared to the barriers identified in the literature review to establish any similarities or trends. The interviews were conducted with industry professionals to obtain a perspective from service providers in determining whether these organisations experience any barriers or

resistance from companies in the uptake of electronic signatures. The questionnaire was completed by senior personnel of organisations which are potential or existing users of electronic signatures, to gain an understanding in the motivation behind the resistance from consumers. These mechanisms are detailed in the following paragraphs.

2.1.1 LITERATURE REVIEW

The author considered electronic signatures as an example of environmentally friendly technologies that encourages sustainable consumption by way of waste minimisation, however with very little research on electronic signatures (especially in South Africa), the author followed a broader literature approach on environmentally friendly technologies. The purpose of the literature review, was to identify the barriers that were and are experienced by other environmentally friendly technologies in the adoption and full implementation thereof. This data was used to lay a foundation for exploring the barriers presented to the implementation of and full conversion to electronic signatures and address research question 2. The author explored renewable energy, cloud computing, electric vehicles, e-learning and sustainable building in several countries, for which data was available, to determine which barriers have been identified in the implementation thereof. The leading barriers were extracted and compared to establish whether a trend exists. The literature review was utilised to inform the questionnaire.

2.1.2 THE QUESTIONNAIRE

The author made a list of industries and targeted senior personnel from small, medium and large enterprises falling within each industry, via email, Facebook and LinkedIn to complete the questionnaire. These industries include construction/manufacturing, legal/judicial, financial, marketing/sales/retail, agricultural, educational, mining, IT/telecommunications, design/photography, medical, entertainment, transport, government and HR/recruitment. The purpose of the broad industry approach lies in the reasoning that all industries sign documents and not only a selected few. Certain challenges faced in receiving responses include recipients' firewalls identifying the link

as potentially harmful, recipients not reading their emails, outdated email addresses which are no longer active, people not reading the post on social media and internal IT systems not allowing access to unknown websites.

The barriers identified in the literature review, were used as a guide in the construction of the questionnaire. All participants were prompted to provide their age, in order for the author to determine if age is a leading factor in the resistance in implementing electronic signatures. The purpose of the questionnaire was to determine whether the participants are aware of the ECT Act and identify the barriers experienced by companies, which prevent them from fully implementing and converting to electronic signatures, and in the process address the research aim, research question 1 as well as research question 2. The questionnaire was completed online in electronic format by clicking on a hyperlink. The information was gathered using closed-ended questions in the questionnaire, as well as offering the participants an opportunity to identify their own barriers, which were not listed in the questionnaire and provide recommendations to overcome the barriers identified. Refer to Annexure A for a complete list of questions as per the questionnaire, as well as the possible answers to select.

2.1.3 INTERVIEWS

The author furthermore researched the companies providing electronic signature solutions in South Africa, requesting an interview with all, for the purpose of gaining information from the widest possible angle. Unfortunately, one of the companies felt that exploring the barriers, constitutes negative publicity and did not want to be associated. Nevertheless, the author attended a seminar presented by the South African Post Office (trust centre) and conducted interviews with three other services providers in South Africa.

An interview is a popular method of gathering data in a qualitative research method (Holstein & Gubrium, 2004; Nunkoosing, 2005). The author conducted interviews with the following people from companies that offer digital signature solutions in South Africa: Hendrik Strydom from JMR (Eezi-Sign), Ken Moyle from DocuSign and Leon Van Der Merwe from Pitney Bowes (PB Verify). The digital signature offering in South Africa is still very small-scale and limited, therefore not a multitude of companies were

available for interview. The purpose of the interviews, was to identify the leading barriers from a service provider's perspective and experience (Harvey, 2015), and in doing so, address the research aim and the second portion of research question 2.

2.2 TRUSTWORTHINESS OF THE STUDY

The trustworthiness of the study relates to any aspects that may have an influence on the accuracy or reliability of the results.

2.2.1 ETHICS

For the author to guarantee the validity and reliability in this study, the exploration and research had to be carried out in an ethical manner (Merriam, 1998). The results obtained from the literature review are reflected in an accurate manner to ensure the integrity of the results and avoid any bias into the interpretation thereof. The ethical consideration pertaining to the results obtained from questionnaires, have been applied as to protect the participants' personal information as envisaged in the Protection of Personal Information Act (South Africa, 2013) and to use the information obtained, strictly for research purposes. An ethics clause was displayed on-line, which explained what the questionnaire was about, what the results were used for, background to the research topic and confidentiality. Participants to the questionnaires were re-assured that their names, as well as the names to their companies will remain confidential and will not appear in the study. Before the questionnaire was made available online, the questionnaire was submitted to the ethics committee at the North-West University, which approved the intended questions. Prior to the commencement of the interviews, the interviewees were informed that the author of this research was an employee of a company at the time, which also offers digital signature services and may result in a conflict of interest, therefore no confidential information should be exchanged. The interviewees furthermore, signed a release form in order for the author to utilise their names in this research.

2.2.2 CREDIBILITY & DEPENDABILITY

Credibility is considered to be a vital element in creating trustworthiness in a study (Lincoln & Guba, 1985). Researchers have introduced certain elements to encourage assurance (Shenton, 2004), which the author has incorporated into this study and addressed as follows:

- The author deliberately encouraged random sampling of individuals to complete the questionnaires, to assist in the avoidance of researcher bias (Shenton, 2004). The link to the questionnaire was distributed via LinkedIn, WhatsApp, Facebook as well as email, to increase participation and obtain an objective perspective (Stake, 1994).

- Tactics to assist in ensuring honesty during the completion, include a voluntary completion of the questionnaire, as well as the assurance to participants that their personal information will be kept private and confidential.

- Peer scrutiny of the research project was obtained by presenting to peers and academic staff during colloquiums throughout the year, whereby questions, comments and criticism were welcomed and taken into account.

- The author was in contact with her supervisors on a regular basis and regularly received commentary which was considered. The research was reviewed on a regular basis to ensure the flow and accuracy of the content.

- The author's background, qualifications and experience, sprout from a legal background, combined with compliance and quality assurance. The author has a law degree, is an admitted attorney and worked at an information security company offering electronic signatures solutions.

- The author used her best endeavors to exclude or minimise researcher bias. As a result of the author working at a company providing the technology to create an electronic signature at the time, this study might be viewed as having an ulterior motive. To the contrary, the author merely aimed to explore her hypothesis and obtain an objective perspective from anonymous participants to address the problem statement.

Dependability relates to whether the results would be similar if the same study was undertaken, using the same techniques and same participants (Shenton, 2004). Dependability and credibility are closely related and to some extent, credibility contributes towards dependability (Lincoln & Guba, 1985). In order for the study to be dependable, the author has laid down precisely how information was obtained as well as the manner in which the research was conducted.

2.2.3 TRANSFERABILITY

Transferability relates to whether the results of one study can be utilised in other scenarios as well (Merriam, 1998). Even though the findings to this study relate to electronic signatures, the results of other case studies considered in the literature review as well as the results of this study, can be utilised in other scenarios. The motivation behind transferability is the fact that the research relates to human behaviour in a sense and how people react to new technology or change. It is likely that this research can be applicable in the implementation of other technologies and the implementation of other new initiatives.

2.2.4 CONFIRMABILITY

Although ultimate objectivity in research is difficult when involving the human factor, the author made use of not only professional experience, research results presented in a seminar, as well as a questionnaire and interviews to minimise researcher bias and improve objectivity (Patton, 1990). In this study, the author displayed the results obtained as well as her interpretation thereof, leaving the reader to distinguish between raw results and processed information. The questionnaire was completed and submitted online, after which the results were captured and calculated automatically, using a formula, to exclude human error or tampering.

CHAPTER 3: AN INTRODUCTION TO ELECTRONIC SIGNATURES IN SOUTH AFRICA

3.1 THE ELECTRONIC COMMUNICATIONS AND TRANSACTIONS ACT

The ECT Act commenced on 30 August 2002 and has been in force for over 13 years. In the author's experience many people appear to be unfamiliar with the contents of this legislation, let alone the existence thereof. The author will utilise research question 1 to determine the accuracy of her hypothesis. In effect, this Act affects nearly everyone who communicates and transacts electronically. The main purpose of this Act is, amongst others, to *"enable and facilitate electronic communications and transactions in the public interest"* (South Africa, 2002). In the years that the ECT Act has been the authority for electronic transactions in South Africa, the technology used for electronic signatures has progressed not only to an acceptable South African standard, but to an international level as well (UNCITRAL, 2001). The United Nations Commission on International Trade Law's model on electronic signatures (UNCITRAL), had a very strong influence in the drafting of the ECT Act, as several of the provisions are the same or similar. Furthermore, South African companies providing the mechanism to create digital signatures using Public Key Infrastructure (PKI), which operates on the principle of a key-set (one of which is private and only known to the owner thereof), have to comply with ISO 21188:2006, which is an international standard. To gain more insight into the application of this Act, a few sections of importance will be discussed below.

Section 11 of the ECT Act, deals with the legal recognition of electronic data (also referred to as a data message). This section provides that *"information is not without legal force and effect merely on the grounds that it is wholly or partly in the form of a data message"*, therefore providing authorisation to draft, store and access information in electronic format. For the majority of documents signed, there is no need to sign it with a manuscript signature, in order for it to be valid; however there are a few exceptions in this regard.

Section 12 of the ECT Act, addresses the requirement present in various corporate agreements, which relates to a document and any subsequent amendments to be in writing. This section provides that the *"requirement in law that a document or information must be in writing is met if the document or information is -*

(a) in the form of a data message; and

(b) accessible in a manner usable for subsequent reference."

Therefore if information is in electronic format and able to be viewed as such, the writing requirement in law has been satisfied.

Section 13 is the most important section for purposes of this paper, in that it deals with electronic signatures. The section provides that:

"(1) Where the signature of a person is required by law and such law does not specify the type of signature, that requirement in relation to a data message is met only if an advanced electronic signature is used" (South Africa, 2002). Law, as referred to in this context, includes not only statutory legislation, but also common law as well as secondary legislation (Spring Forest Trading v Wilberry, 2014) explicitly stating that a document has to be signed in order to be valid. Examples of such documents are employment contracts (South Africa, 1997), suretyship agreements (South Africa, 1956) and a franchise agreement (South Africa, 2008b).

"(2) …an electronic signature is not without legal force and effect merely on the grounds that it is in electronic form" (South Africa, 2002). This sub-section explains that in essence, an electronic signature will have the same force and effect as a manuscript signature.

"(3) Where an electronic signature is required by the parties to an electronic transaction and the parties have not agreed on the type of electronic signature to be used, that requirement is met in relation to a data message if-

(a) a method is used to identify the person and to indicate the person's approval of the information communicated; and

(b) having regard to all the relevant circumstances at the time the method was used, the method was as reliable as was appropriate for the purposes for which the information was communicated" (South Africa, 2002).

Section 13(3) seems strict at first glance, but in a recent supreme court of appeal judgment (Spring Forest Trading v Wilberry, 2014), the interpretation of this section came under fire and was expressed that the name of a person at the bottom of an

email, can constitute an electronic signature. The judge in this case held that *"so long as the 'data' in an email is intended by the user to serve as a signature and is logically connected with other data in the email the requirement for an electronic signature is satisfied"* (Spring Forest Trading v Wilberry, 2014). The judge went further as to confirm that the reliability of an email and the accuracy of the information communicated between the parties, conform to the requirements set out in section 13(3)(b).

"(4) Where an advanced electronic signature has been used, such signature is regarded as being a valid electronic signature and to have been applied properly, unless the contrary is proved" (South Africa, 2002). The use of an Advanced Electronic Signature (AES) is therefore *prima facie* proof that the signature is valid and binding. The burden of proof thus shifts to the person alleging and not the person who signed with an AES.

"(5) Where an electronic signature is not required by the parties to an electronic transaction, an expression of intent or other statement is not without legal force and effect merely on the grounds that -

(a) it is in the form of a data message; or

(b) it is not evidenced by an electronic signature but is evidenced by other means from which such person's intent or other statement can be inferred" (South Africa, 2002). This section confirms that an expression of intent in electronic format will be valid and admissible.

From these brief extracts, it is clear that, electronic signatures and electronic documents are permitted and legally enforceable, thus, allowing for the conversion from paper and the implementation of a digital means of transacting and signing. The ECT Act enables the people of South Africa to transact electronically without having the apprehension of the document being declared invalid because it hasn't been reduced to paper. Not only South Africa, but across the world, similar legislation has been enacted to regulate electronic commerce and electronic signatures (Spring Forest Trading v Wilberry, 2014). Although the provisions differ slightly, the underlying principles remain the same.

Schedule 2 of the ECT Act (South Africa, 2002), however excludes four types of transactions, which may not be signed electronically. These transactions include a

sales agreement for immovable property, an agreement for a long-term lease in excess of 20 years, a will or codicil and a bill of exchange.

3.2 ELECTRONIC SIGNATURES EXPLAINED

As discussed above, the recent supreme court of appeal decision has clarified what casted doubt in the minds of many companies applying electronic signatures to documents. 'Electronic signature' is an umbrella-term which encompasses different types of signatures (digital and advanced). Figure 2 will aim to illustrate the explanation of electronic signatures and their association with one another.

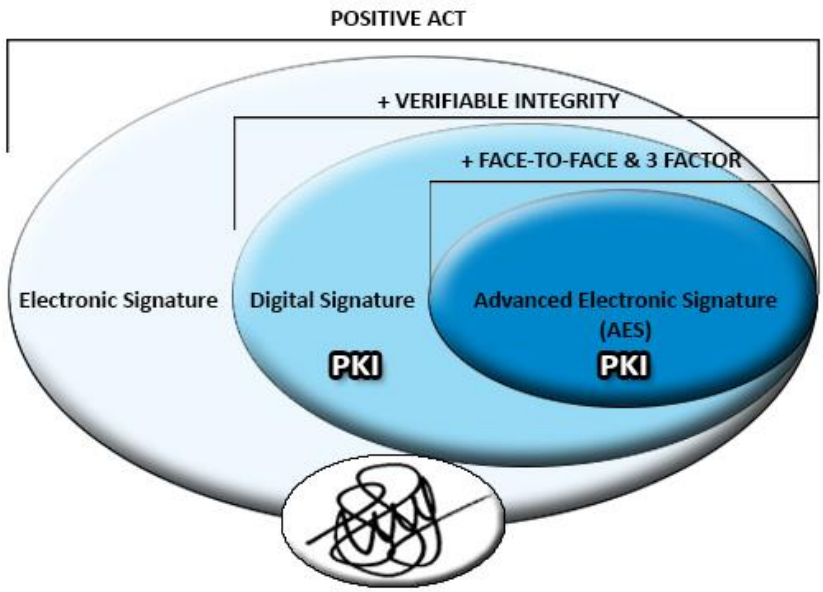


Figure 2: Adaptation of an explanation of Electronic Signatures (Maherry, 2014)

An electronic signature, is therefore the concept utilised that encompasses both digital signatures and AES. The smaller the circle, the more security mechanisms are added for increased reliance and trust, which makes AES the most secured and trustworthy signature available at present. As a result of the definitions relating to electronic- and digital signatures differing internationally (Ghana, 2008; Poland, 2001), it is vital to carefully consider the definitions of electronic signatures in the country in which the signature is applied. For purposes of this paper, the author will aim to illustrate the meaning of electronic signatures in South Africa, based on the definitions as per the ECT Act (South Africa, 2002).

An electronic signature is defined as "*data attached to, incorporated in, or logically associated with other data and which is intended by the user to serve as a signature"* (South Africa, 2002). This definition is not very clear in explaining exactly what constitutes an electronic signature and can be open to interpretation. This definition can be simplified - an electronic signature needs to consist of a positive act, it must be able to identify the signatory, the signature must be verifiable and it must be visible. All of these characteristics mentioned, have to be in electronic format for it to qualify as an electronic signature. For an electronic signature to be recognised, the simple intention to sign is required, in order for an image/symbol/name/signature to be recognised as a signature, therefore if the intention for a name at the end of an email, is to serve as an electronic signature, as discussed in the Spring Forest Trading v Wilberry (2014) judgment, it will be sufficient.

A digital signature (although not defined in the ECT Act), is a signature that originates with a digital certificate. A digital certificate is issued to a person, once that person has been verified as the person who they claimed to be. A digital signature requires not only a positive act but also has verifiable integrity as a result of a digital certificate. A digital certificate is a positive identification of a device/server or entity that operates very similar to how an identity document identifies a specific person (Maherry, 2014). A digital certificate is managed by a Public Key Infrastructure (PKI), which is a combination of hardware, software and procedures implemented in order to manage digital certificates (Maherry, 2014; CGI, 2004).

An AES is defined in the ECT Act as "*an electronic signature which results from a process which has been accredited by the Authority as provided for in section 37"*. For the layman, this could result in confusion as the definition in reality, does not define the concept as would be expected. In short, an AES is a digital certificate based signature, which utilises mechanisms to ensure security and integrity, as well as to confirm the identity of the signatory. For clarity, AES consists of a positive act, together with verifiable integrity (digital certificate based on confirmation of the identity of the applicant) with an added face-to-face verification mechanism, as well as 3-factor authentication (or similar). The 3-factor authentication is briefly:

- Something you are (biometrics such as fingerprint and iris scan);

- Something you know (pin, password, pass phrase or secret question);
- Something you have (key, device).

The ‘something similar’ referred to in legislation, would be something that offers the same type of security but does not incorporate all three authentication factors mentioned above. These added mechanisms are what make this type of signature so strong, reliant and trustworthy. As was seen in section 13(4) of the ECT Act, this signature is presumed to be valid, unless proven otherwise, therefore shifting the burden of proof away from the signatory and onto to the person who alleges. Only companies that have been accredited by the South African Accreditation Authority, as mentioned in the definition, which was established under the ECT Act, may issue certificates to create AES. Currently there are only two organisations accredited in South Africa to fulfil this function. One of the reasons for the small number of companies accredited, might be the cost of the audit in order to be certified. The cost is astronomical and for any small to medium size business, such funds are simply not in the budget (Rootshtain at al., 2014). Figure 3 will aim to illustrate the application of PKI and digital signatures.

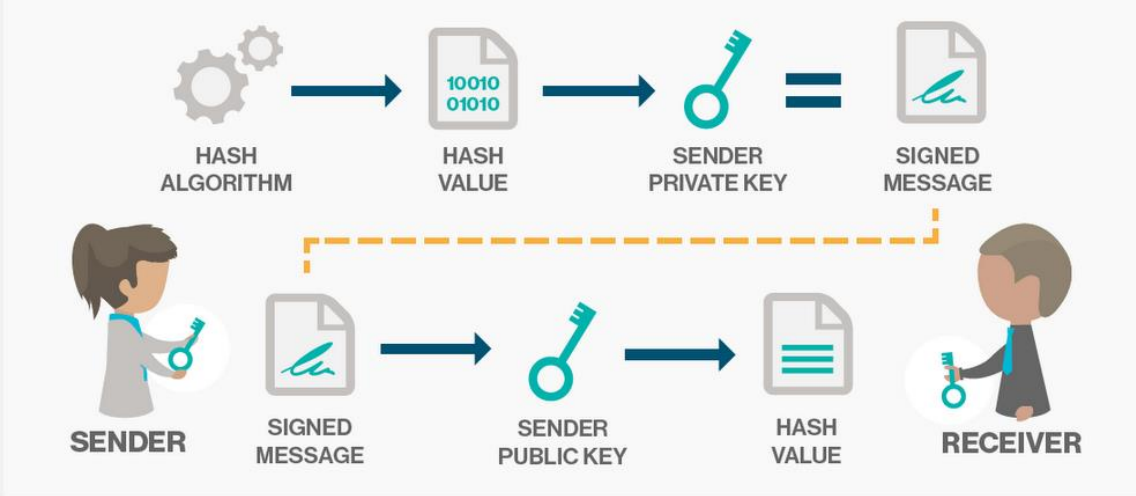


Figure 3: Digital Signature (PKI) application (Rouse, 2014)

Electronic signatures based on PKI (digital signatures and AES), use an algorithm in order to generate two keys, private and public, that are mathematically linked to each other (DocuSign, 2015; Rouse, 2014; Kaliski, 2005). In order to create a digital signature, software is utilised to create a one-way hash (cryptographic process) of the electronic document that is to be signed. The private key that was generated, is used to

encrypt the hash (Rouse, 2014). "*The encrypted hash, along with other information, such as the hashing algorithm, is the digital signature"* (Rouse, 2014). The hash value is unique (Rouse, 2014; CGI, 2004) and prevents any subsequent changes to the document signed (which will alter the hash value and warn the recipient of alterations to the document). The digital certificate used to create a digital signature on an electronic document, links a public key to an identity and can be utilised to confirm who the owner of that public key is (Rouse, 2014).

An AES is therefore the most secure signature available in South Africa. Even though it does not have to be applied to all documents, the user has the option available to use it on all documents. For documents not demanding an AES and not excluded by the ECT Act, an electronic signature would suffice.

CHAPTER 4: ENVIRONMENTALLY FRIENDLY TECHNOLOGIES AND THE BARRIERS TO IMPLEMENTATION

"…technology rich, transformation poor" (Rootshtain et al., 2014)

4.1 SUSTAINABLE CONSUMPTION AND ENVIRONMENTALLY FRIENDLY TECHNOLOGIES

An environmentally friendly technology, is an innovative approach, tool or mechanism, implemented and utilised, to mitigate or reverse the negative effects human activities have or had on the environment (Anon. 2011). Electronic signature applications (which encompass electronic, digital and AES) is an innovative instrument to minimise the production of paper and therefore minimise waste and reduce pollution, and therefore is an example of an environmentally friendly technology. The aim of implementing environmentally friendly technologies, is to attain sustainability as entrenched in NEMA (South Africa, 1998) and the Constitution (South Africa, 1996).

Sustainable consumption is a concept that is defined as "*the use of goods and services that respond to basic needs and bring a better quality of life, while minimizing the use of natural resources, toxic material and emissions of waste and pollutants over the lifecycle, so as not to jeopardize the needs of future generations*" (Ofsted, 1994). When reading the definition of sustainable consumption, several concepts encompassed in NEMA (South Africa, 1998), NEM:WA (South Africa, 2008) as well as the Constitution (South Africa, 1996) are reflected. Sustainable consumption suggests that "*the consumption of current generations as well as future generations improves in quality. Such a concept of consumption requires the optimalization of consumption subject to maintaining services and quality of resources and the environment over time"* (Salim, 1994). Sustainable consumption is driven by a multitude of elements, as discussed by Akenji (2014), such as attitude (values and knowledge), facilitators (incentives and constraints) as well as infrastructure (systems of provision and physical infrastructure).

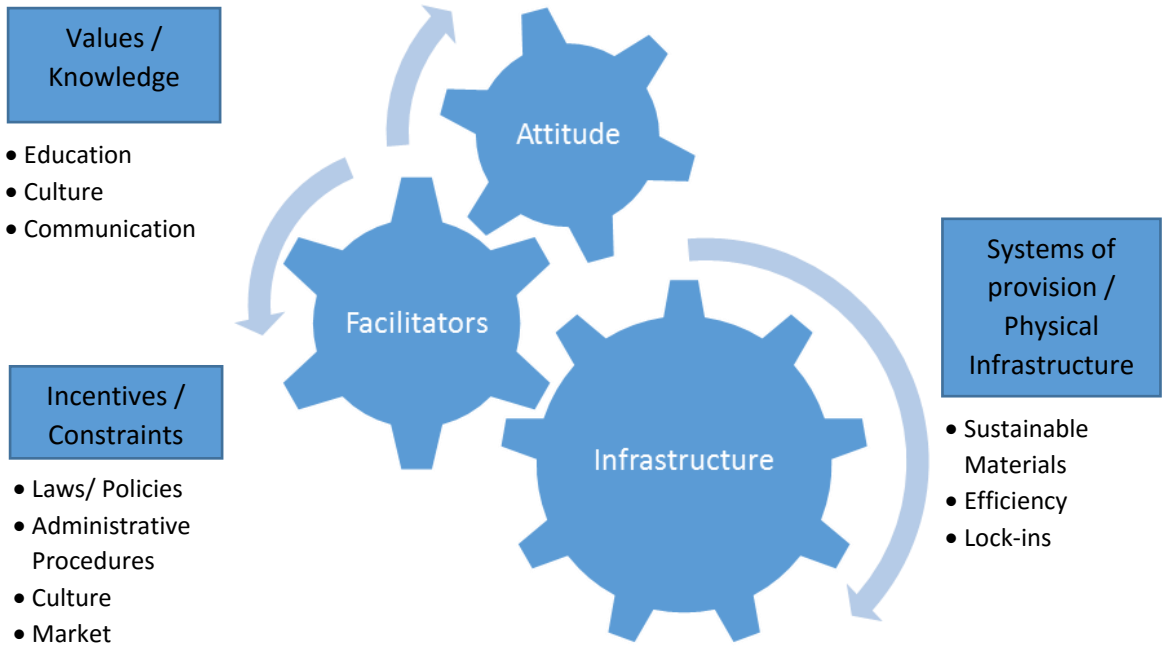


Figure 4: Key elements for mainstreaming sustainable consumption (Akenji, 2014)

As depicted in Figure 4, the elements all have an effect on one another. If any of the elements are absent, it will result in a barrier that will have a direct impact on the inner workings of sustainable consumption. The author will utilise the elements discussed above in categorizing the barriers identified in the literature review, questionnaire and interviews to maintain consistency in terminology.

Very little research exists on electronic signatures, especially in South Africa, which is the reason for the reference to a seminar (Rootshtain *et al*., 2014) presented by Microsoft, CoSign and nVisionIT (in partnership with South African Post Office trust centre, which is one of the leading service providers of electronic signature solutions in South Africa), discussing the business benefits of digital signatures. Despite the fact that the infrastructure, legislation and technology for the creation and management of electronic signatures are at the fingertips of people in South Africa, companies remain reluctant to implement such technologies. With that said, the author endeavors to explore the reasons preventing companies from implementing and fully converting to electronic signatures.

Research carried out in South Africa by Microsoft and ARX (Rootshtain *et al*., 2014), identified attitude as part of the challenge when implementing digital signatures, in that there is a necessity for a definite mind-shift as a result of the following aspects identified:

- People display a lack of trust in the belief that electronic documents can be amended subsequent to signing;
- There is a resistance to change;
- South Africa struggles with a large percentage of the population not being computer literate;
- People like to touch and feel a physical document and are not used to only seeing something on a screen;
- There is a misperception that only paper constitutes the 'original';
- Reading on a screen instead off of a printed document seems problematic.

The aspects identified by Rootshtain *et al*., (2014) all contain elements relating to attitude. Based on Figure 4, presented with a lack of the correct attitude, having the infrastructure and facilitators in place are superfluous, as all the elements are required for the effective working of the system driving sustainable consumption. Environmentally friendly technologies are in no way immuned to the effects of human stimuli, they are similarly affected by the same attitude which affects a number of industries and initiatives.

The above barriers, along with the major barriers identified in the literature review of other environmentally friendly technologies, were used as a guideline in the construction of the questionnaire – refer to Annexure A. Several environmentally friendly technologies, such as renewable energy, waste beneficiation, aquaculture, rainwater harvesting technologies and smart ICT grids (Mohamed, 2013), are currently being developed in South Africa, in an attempt to rehabilitate and reduce the impact on the environment. The author selected the environmentally friendly technologies researched in this study, based on the current trends, latest news and data availability.

Only those barriers cited in more than 50% of the articles will be highlighted and shown according to selection frequency in the leading barrier tables to follow. The selection frequency will be colour coded according the colour scale below.

0-3/8 (0-37.5%)	4/8 (50%)	5/8 (62.5%)	6/8 (75%)	7-8/8 (87.5-100%)
Low		Medium		High

Figure 5: Colour scale

4.1.1 RENEWABLE ENERGY SOURCES

Renewable energy sources occur naturally and replenish post utilisation (Anon, 2015), which therefore "*do not use up the earth's natural resources or otherwise harm the environment, especially by avoiding the use of fossil fuels or nuclear power*" (South African Concise Oxford Dictionary, 2002:31). The implementation of renewable energy will result in a decline in the demand for coal, therefore reducing coal mining activities which have a considerable impact on the environment (Lloyd, 2002). It is speculated that the growth rate of wind and solar energy, is the fastest out of any other technology in the world (Moomaw, 2002). Several countries around the world have already and are currently exploring the possibility of replacing conventional energy with renewable energy, South Africa being no exception. It is important to keep in mind that operative, procedural and governing structures are vital to act as an incentive to the implementation of renewable energy, in order to reduce carbon emissions in the long run (Byrnes *et al*., 2013).

A significant challenge identified in the implementation and future growth of renewable energy in Slovenia, is finding an instrument to encourage further development of the renewable energy industry and enable transformation towards a green energy economy (Al-Mansour *et al*., 2014). Despite being a developing country and reflecting low emissions in the past, China is now facing pressure from all angles to manage its carbon emissions, which has rapidly increased to such an extent that China is regarded as *"the world's largest carbon polluter"* (Lo, 2014). Although research (Byrnes, *et al*., 2013) suggests that Australia has taken momentous strides towards the implementation of renewable energy, certain barriers persist (Byrnes, *et al*., 2013):

Table 1: Renewable energy barriers identified in Australia (Byrnes *et al*., 2013)

Barriers identified	Facilitators	Attitude	Infrastructure
Time consuming and exhausting administrative processes	✓		
High costs	✓		
Inadequate regulatory framework	✓		
Refusal to accept by the public		✓	
High competing costs	✓		
Governmental monopoly over existing sources of electricity – lack of support from government	✓		
Refusal to change and fear of the unknown		✓	

The US is no stranger to renewable energy, in fact, in 2013 alternative sources of energy made up 10% of total US energy usage and 13% of electricity generation (EIA, 2014). Research done in North America on renewable energy, highlighted policies, legislation and rules, that do not correspond or promote renewable energy/technology, as the leading barrier experienced in the implementation of renewable energy (Moomaw, 2002). The barriers to renewable energy identified in the US (Beck & Martinot, 2004) relate to the following:

Table 2: Renewable energy barriers identified in US (Beck & Martinot, 2004)

Barriers identified	Facilitators	Attitude	Infrastructure
Lack of funding and high costs	✓		
Inadequate legislative and regulatory provisions.	✓		
Lack of governmental support. In many instances governmental support, such as subsidies influence people's behaviour towards adopting a new technology	✓		
Lack of infrastructure			✓
Market performance, which includes lack of skills, uncertainty and access to funds. Uncertainty tends to make people anxious, fearful and contributes to bad decision-making.		✓	

To the south of the US, in Mexico, funding seems to be the largest barrier to the implementation of renewable energy technology, mainly as a result of the subsidy offered by the government for conventional electricity (Sandia, 1998). Besides India being a developing country (ISI, 2015), it will be hosting the 9th annual renewable energy expo, which was be held in September 2015 (UBM, 2015). This indicates that the development and research behind renewable energy sources have come a long way. Research indicated that India experienced the following barriers (Luthra *et al*., 2015):

Table 3: Renewable energy barriers identified in India (Luthra *et al*., 2015)

Barriers identified	**Facilitators**	**Attitude**	**Infrastructure**
Initial cost being too high	✓		
Lack of governmental support or subsidiary relief	✓		
Inadequate regulatory framework	✓		
No incentives or financial assistance	✓		
Distance between point of availability is too far from the consumption point			✓
Insufficient technology			✓
Lack of knowledge, experience and awareness was identified as the most vital barrier		✓	
The renewable energy market base is too small	✓		
Lack of infrastructure			✓
Shortage of natural and renewable resources			✓
Electricity demand is too high	✓		
Refusal to change due to uncertainty/fear		✓	
Lack of public interest		✓	

Taking the reins in the electricity sector, and having an array of natural resources available for renewable energy, the president of Chile introduced a target of producing 20% of the electricity from renewable sources by 2020 (Von Hatzfeldt, 2013). Even a country such as Chile, with such high aspirations and growth in this regard, has experienced barriers in its mission to attain its goal:

Table 4: Renewable energy barriers identified in Chile (Von Hatzfeldt, 2013)

Barriers identified	Facilitators	Attitude	Infrastructure
Lack of funding due to a lack of understanding	✓	✓	
Lack of governmental support, which includes delay in procedure and inadequacy to deal with the integration of energies	✓		
Monopoly of energy suppliers – no space for new players in the energy sector	✓		

Renewable energy has become a point of discussion as a result of the rapid rise in energy consumption in the GCC region (Gulf Cooperation Council; which comprises of the UAE, Bahrain, Saudi Arabia, Oman, Qatar and Kuwait) (Gastli & Armendáriz, 2013). The leading barriers identified in this region are:

Table 5: Renewable energy barriers identified in GCC (Gastli & Armendáriz, 2013)

Barriers identified	Facilitators	Attitude	Infrastructure
Lack of awareness		✓	
Inaccurate historical climate data	✓		
Inadequate regulatory framework	✓		
Insufficient technology			✓
Energy price subsidies offered by the government to conventional energy sources	✓		

The Department of Energy (South Africa) introduced a White Paper on Renewable Energy in 2003, which reflects a goal of producing 10,000GWh of power from renewable energy sources by 2013. A report on South Africa's renewable energy policy (Edkins *et al*., 2010) indicates that an excess of 90% of South Africa's electricity is produced by burning coal. In reaction to the slow progress made by the Department of Energy, a Renewable Energy Independent Power Producer Procurement Programme was introduced in 2011 (Wlokas *et al*., 2012) to assist in achieving the renewable energy target. In order for any national or international renewable energy project developer to enter the renewable energy market in South Africa, certain rigorous procedures have to be followed before the project will even be considered (Wlokas *et al*., 2012), and in itself, poses a great barrier to the development of renewable energy

sources. Further research conducted in South Africa (Musango *et al*., 2011) has recognised the following barriers:

Table 6: Renewable energy barriers identified in South Africa (Musango *et al*., 2011)

Barriers identified	Facilitators	Attitude	Infrastructure
Lack of available natural resources			✓
High costs and lack of investors	✓		
Co-operative government – too many departments are involved, but inadequate policies and procedures and sluggish approval process	✓		
Lack of infrastructure			✓
Poor research and development	✓		
Lack of skilled and technical workers	✓		
Social barriers – possibility of rejection by community		✓	

The barriers presented in the exploration of renewable energy options and the full potential it holds, *"are universal and not much different from other countries and are not related to the size of the country or economy"* (Al-Mansour *et al*., 2014:74). The reasons why so many countries have not implemented renewable energy and have fallen behind with renewable energy development are identified by Gastli & Armendáriz (2013):

Table 7: Renewable energy barriers identified by Gastli & Armendariz (2013)

Barriers identified	Facilitators	Attitude	Infrastructure
Lack of awareness among the community as well as the decision makers		✓	
High initial costs	✓		
Fear of change and the unknown		✓	
Unreliable policy and procedural framework	✓		
Little sectorial motivation	✓		
No or insufficient incentive programmes	✓		
Lack of skilled workers		✓	
Lack of adequate sources relating to suitable technologies for the present and the future			✓

These barriers identified by Gastli & Armendáriz (2013) in the GCC region, correspond with the leading barriers identified from the participants above. The table below reflects the leading barriers, as were identified in the research examined.

Table 8: Leading Barriers to the Implementation of Renewable Energy Sources

	Slov	Aus	US	Mex	India	Chile	GCC	S.A
Facilitators								
Inadequate Regulatory framework		✓	✓		✓		✓	✓
Lack of governmental support		✓			✓	✓	✓	✓
Lack of Incentives	✓				✓		✓	
Hampering Administrative Processes		✓						✓
Lack of skilled workers							✓	✓
High Costs / Lack of Funding		✓	✓	✓	✓	✓	✓	✓
Attitude								
Uncertainty / Fear		✓	✓		✓	✓	✓	✓
Lack of Awareness			✓		✓	✓	✓	
Infrastructure								
Lack of Infrastructure			✓		✓			✓
Insufficient Technology					✓		✓	
Lack of Available Natural Resources					✓			✓

The most prominent barriers reflected, emanate from countries identifying facilitators as a barrier. The elements under facilitators are high costs/lack of funding, governmental resistance and inadequate regulatory framework. The government of a country has the power to provide the necessary legislation and regulatory framework as well as financial support in the form of subsidies. If subsidies are offered to companies for instance Eskom, which is South Africa's energy generator (using coal), the level of growth and progress in renewable sources of energy will be hampered and slowed down considerably. It can further be construed that the other leading barriers identified relate

to attitude. The elements identified under attitude relate to uncertainty/fear and lack of awareness.

4.1.4 ELECTRIC VEHICLES

Electric vehicles are essentially battery operated vehicles (Anon. 2014a), propelled by one or more electric motors, instead of a combustion engine (Faiz *et al*., 1996), which contributes towards emissions and pollutes the environment. Despite the fact that the Joule project, in which a local company aimed to produce an affordable and workable electric vehicle, failed, as a result of a lack of funds (Eliseev, 2012), South Africa introduced the Nissan Leaf in 2013 (Sanchez, 2014) and BMW i3 and BMW i8 in 2015. General observations on the South African roads, are indicative that there has to be barriers present behind the vast majority of road users, still driving combustion engine propelled vehicles.

Research carried out by an Israeli company that develops infrastructure for electric vehicles (Naor *et al*., 2015), identified the following barriers to prevent the adoption of electric vehicles:

Table 9: Electric vehicle barriers identified in Israel (Naor *et al*., 2015)

Barriers identified	Facilitators	Attitude	Infrastructure
High costs	✓		
Limited range of electric vehicles	✓		
Safety concerns		✓	
Negative misperceptions of electronic vehicles		✓	
Lack of or inadequate Infrastructure			✓
Fear of change		✓	

A market research report (Anon. 2014a) compiled on India, reflects that the barriers for the implementation and use of electric vehicles are as follows:

Table 10: Electric vehicle barriers identified in India (Anon. 2014a)

Barriers identified	Facilitators	Attitude	Infrastructure
Lack of performance in vehicles	✓		
Battery proving to be inefficient	✓		
Prices are too steep	✓		
Power shortage			✓
Lack of charging infrastructure			✓

According to Slavin (2014), the National Research Council of the National Academies published a report on the barriers to electric vehicle distribution. The leading barriers identified in this report are as follows:

Table 11: Electric vehicle barriers identified by Slavin (2014)

Barriers identified	Facilitators	Attitude	Infrastructure
Cost of purchasing an electric vehicle	✓		
The limited range that an electric vehicle can travel	✓		
Limited charging infrastructure			✓

In a study carried out, including both the US and China, it reflects that although the electric and hybrid vehicle market in North America has grown by more than 400% since 2005, safety still remains a barrier to the adoption of electric vehicles (Marlay, 2013). In 2013, less than 0.1% of the total number of passenger vehicle sales, were electric vehicles in China (Sohu, 2014), reflecting that 99.9% were still combustion engine vehicles. Another study carried out on the electric vehicle market in China (Wan *et al*., 2015) identified the following barriers:

Table 12: Electric vehicle barriers identified in China (Wan *et al*., 2015)

Barriers identified	Facilitators	Attitude	Infrastructure
Protection by local government (government offering subsidies to non-electric vehicles manufacturers)	✓		
Uncertainty by consumers		✓	
Insufficient charging infrastructure			✓
Battery prices are too steep	✓		

Research done in the US on the consumer attitudes and perceptions to the widespread adoption of electric vehicles, noted that *"consumers tend to be resistant to new technology that is considered unfamiliar or unproven"* (Egbue & Long, 2012:718-719). Further research carried out in the US, focusing on non-costs barriers to the adoption of electric vehicles (ANL, 2013), identified the following barriers:

Table 13: Electric vehicle barriers identified in US (ANL, 2013)

Barriers identified	Facilitators	Attitude	Infrastructure
Limited vehicle range	✓		
Lack of fueling or charging stations			✓
Charging and fueling – time consuming	✓		
Limited range of models available	✓		
Lack of available information	✓		
Unfamiliarity and uncertainty		✓	
False perceptions by consumers		✓	
Lack of regulatory documents, providing industry standards	✓		
Regulations placing restrictions on electric vehicles	✓		

As part of a working paper (Tsang *et al*., 2012), research carried out in Europe, reflects the following barriers that prevent wide implementation of electric vehicles:

Table 14: Electric vehicle barriers identified in Europe (Tsang *et al*., 2012)

Barriers identified	Facilitators	Attitude	Infrastructure
Safety concerns		✓	
Resistance by industry stakeholders		✓	
Vehicle performance, which includes limited range, battery performance as well as charging times	✓		
High costs, both at date of purchase and maintenance	✓		
Limited charging infrastructure			✓
Lack of knowledge and understanding		✓	
Failure to make a change (take action)		✓	

A study carried out in Lithuania (Raslavičius *et al*., 2015), identified the following weaknesses and threats, which could hamper electric vehicle implementation and wide acceptance:

Table 15: Electric vehicle barriers identified in Lithuania (Raslavičius *et al*., 2015)

Barriers identified	Facilitators	Attitude	Infrastructure
Poor representation by manufacturers	✓		
Strong second-hand vehicle market	✓		
High costs	✓		
High prices of batteries	✓		
Political agendas, usually driven by money	✓		
Inadequate regulatory framework	✓		
Lack of governmental support	✓		
Lack of skilled workers	✓		
Uncertainty relating to the technology, performance, safety and resale value of the vehicle		✓	
Lack of available information	✓		

Sanchez (2014) reiterates that the citizens of South Africa will not purchase electric vehicles, if the charging infrastructure is not available. Schneider Electric, in partnership with BMW (BMW Group, 2014), aims to address this by implementing such infrastructure and technology, which will commence in 2015. The previous statement rings very true, however, besides not having the infrastructure, South Africa is faced with an even larger challenge in the form of electricity supply. With an announcement from the Minister of Public Enterprises, that South Africa should prepare for regular loadshedding (planned power cuts) until 2018 (Ntingi, 2015), having the infrastructure at our fingertips, might not be of any benefit if there is no electricity to power the charging infrastructure. The table below reflects the leading barriers to the adoption of electric vehicles, which were identified in the research evaluated.

Table 16: Leading Barriers to the Adoption of Electric Vehicles

	Israel	India	Slavin	China	US	Eur	Lith	S.A
Facilitators								
High costs / Lack of funding	✓	✓	✓	✓		✓	✓	
Lack of governmental support				✓			✓	
Lack of available information					✓	✓	✓	
Inadequate regulatory framework					✓		✓	
Attitude								
Uncertainty / fear	✓			✓	✓	✓	✓	
Safety concerns	✓			✓	✓	✓		
Infrastructure								
Limited vehicle range	✓		✓		✓			
Poor vehicle performance		✓			✓	✓		
Lack of infrastructure	✓	✓	✓	✓	✓	✓		✓
Unstable power supply		✓						✓

The most prominent barrier identified in the studies reviewed, appear to be infrastructure. The lack of infrastructure is an element recognised by 7 out of the 8 sample studies. Less critical barriers relate to facilitators with high costs/lack of funding as the foremost element as well as attitude with uncertainty/fear and safety concerns as key elements.

4.1.5 SUSTAINABLE BUILDING

Sustainable building can be defined as the architecture of buildings, utilising techniques and supplies that are considered to be "*resource efficient"* and that will not have a negative impact on environmental wellbeing *"or the health and well-being of the occupants, construction workers, the general public, or future generations"* (Landman, 1999). Sustainable building should drastically reduce the harmful materials utilised in the building and construction industry. Progressively, governments and the general public, realise the need for a more sustainable building practice, which includes

sustainable material used during construction (Davis, 2001). It is interesting to note, that the City of Tshwane, which is a metropolitan municipality in Gauteng, South Africa, has introduced a Green Building Development By-Law (City of Tshwane, 2013). In this By-law, provision is made for a Green Building Development Policy aimed *"to improve the performance of built environments in order to reduce negative or adverse environmental impacts, to improve the quality of the environment and to enhance the quality of life in the city"* (City of Tshwane, 2013). Whether this by-law is successfully enforced and implemented by the building industry, is unclear and not under discussion in this paper.

A study carried out on the building movement in China (Yang, 2015), reflects the following challenges presented in the implementation of sustainable building:

Table 17: Sustainable building barriers identified in China (Yang, 2015)

Barriers identified	**Facilitators**	**Attitude**	**Infrastructure**
Technological challenges			✓
High costs	✓		
Inadequate regulatory framework	✓		
No proper rating systems	✓		
Lack of awareness		✓	
Lack of education and knowledge		✓	

Research conducted by Samari *et al*., (2013) on sustainable buildings in Malaysia, explored the barriers presented and concluded that none of the barriers identified stemmed from a lack of infrastructure. The following barriers were identified to be significant:

Table 18: Sustainable building barriers identified in Malaysia (Samari *et al*., 2013)

Barriers identified	Facilitators	Attitude	Infrastructure
Lack of funds for the initial costs (including technological advancements) to design and erect buildings;	✓		
The high risk of investing in a sustainable building;	✓		
There seems to be a lack of demand, which could be attributed to the fact that the general public is unaware and uneducated on the subject;		✓	
The final price of the building is higher;	✓		
Inadequate regulatory framework to regulate or encourage sustainable building, which links to the lack of governmental support;	✓		
The contractors (builders) have no incentive to want to build sustainable buildings.	✓		

In Finland, research was carried out on the barriers and drivers for sustainable building, utilising literature, case studies, interviews and workshops (Häkkinen & Belloni, 2011). These are the leading barriers uncovered:

Table 19: Sustainable building barriers identified in Finland (Häkkinen & Belloni, 2011)

Barriers identified	Facilitators	Attitude	Infrastructure
Unknown risks posed by sustainable building		✓	
Unforeseen costs, in the commencement phase and later	✓		
Lack of understanding by client		✓	
Grueling process – procurement, timing, networking, approvals, cooperation etc.	✓		
Lack of knowledge and understanding		✓	
Availability of instruments and methods	✓		

A study carried out on green roof systems in Hong Kong (Zhang *et al*., 2012), which also forms part of sustainable building, raised the following barriers as concerning:

Table 20: Sustainable building barriers identified in Hong Kong (Zhang *et al*., 2012)

Barriers identified	Facilitators	Attitude	Infrastructure
Little support and promotion from government as well as social communities	✓		
Lack of incentives to both home owners and developers	✓		
Increase in maintenance costs	✓		
Lack of awareness		✓	
Refusal to accept the new and move away from the old existing buildings		✓	
Technical difficulties			✓
Weak structures, which cannot adequately support green roof systems			✓
Increase in costs	✓		
Poor provisions of utilities	✓		

In California, US, several people involved in the construction and building industry, were interviewed in a study which identified the following three leading barriers (Davis, 2001):

Table 21: Sustainable building barriers identified in California, US (Davis, 2011)

Barriers identified	Facilitators	Attitude	Infrastructure
High costs for builders and developers;	✓		
Information on green products and sustainable buildings is lacking and is not readily available;	✓		
The client is not educated on sustainable buildings and lacks the knowledge to make an educated decision to implement such green initiatives.		✓	

Research carried out in Oregon, US, (Griffen *et al*., 2010) identified the following barriers encountered in the implementation of sustainable structural materials:

Table 22: Sustainable building barriers identified in Oregon, US (Griffen *et al*., 2010)

Barriers identified	Facilitators	Attitude	Infrastructure
The public's perception of high costs		✓	
Inadequate regulatory framework that accredits new green materials and green initiatives	✓		
Sustainable materials are not easily accessible or available			✓
Lack of availability of information on sustainable building materials as well as dependable information detailing substitute structural materials and systems	✓		

From a study carried out in Nigeria (Ikendiashi *et al*., 2012), the leading barriers identified were:

Table 23: Sustainable building barriers identified in Nigeria (Ikendiashi *et al*., 2012)

Barriers identified	Facilitators	Attitude	Infrastructure
Lack of training/education		✓	
Not having the correct tools			✓
No legislation and policies enforcing sustainable buildings	✓		
Lack of knowledge and awareness		✓	

In 2014 research was conducted in Brazil to determine barriers to sustainable building at two engineering schools (Kasai & Jabbour, 2014). The following barriers were identified:

Table 24: Sustainable building barriers identified in Brazil (Kasai & Jabbour, 2014)

Barriers identified	Facilitators	Attitude	Infrastructure
Lack of incentives for the reduction of the cost of maintenance	✓		
Uncertainty relating to measure the level of sustainability of a building		✓	
High initial costs	✓		
Unsatisfactory level of environmental skills and knowledge amongst the industry professionals		✓	
Poor communication within the industry		✓	
Very little research available on sustainable building	✓		
Lack of procedural guidelines and technical standards in Brazilian	✓		
Because this is a new concept, there is not adequate training and material available to employees	✓		
Lack of professional and skilled employment available in the sustainable building industry	✓		
Fear of change due to cultural barriers		✓	

A study conducted in Kwa-Zulu Natal, South Africa (Hankinson & Breytenbach, 2012), reflected the following leading barriers, identified by participants, which result in a lack of implementation of sustainable design and building:

Table 25: Sustainable building barriers identified in South Africa (Hankinson & Breytenbach, 2012)

Barriers identified	Facilitators	Attitude	Infrastructure
High costs	✓		
Lack of knowledge, education and experience		✓	
Unreliable materials			✓
Hesitation and resistance from clients		✓	

The table below will provide a concise reflection of the barriers identified.

Table 26: Leading Barriers to Implementation of Sustainable Building

	China	Malaysia	Fin	H Kong	US	Nig	Braz	S.A
Facilitators								
High Costs / Lack of funding	✓	✓	✓	✓	✓		✓	✓
Lack of incentives		✓		✓			✓	
Lack of governmental support		✓	✓	✓	✓	✓	✓	
Lack of available information			✓		✓	✓	✓	
Lack of skilled workers						✓	✓	✓
Inadequate regulatory framework	✓	✓				✓	✓	
Attitude								
Uncertainty / fear		✓	✓	✓			✓	✓
Poor decisions by uneducated clients	✓	✓	✓		✓	✓		✓
Lack of awareness	✓	✓	✓	✓	✓	✓	✓	✓
Infrastructure								
Lack of tools, material and methods			✓	✓	✓	✓		✓
Poor infrastructures			✓	✓				

There appears to be a definite trend that manifests itself in the type of barriers that are presented to the implementation of sustainable building. As reflected above, all of the participant studies identified a lack of awareness as an element that forms part of the attitude barrier, followed by poor decisions by uneducated clients and uncertainty/fear as elements. Other leading barriers relate to facilitators with high costs/lack of funding, lack of governmental support and inadequate regulatory framework as elements as well as infrastructure with lack of tools, materials and methods as an element.

4.2 AIMING FOR SUSTAINABILITY THROUGH WASTE MINIMISATION, USING ENVIRONMENTALLY FRIENDLY TECHNOLOGIES

4.2.1 E-LEARNING

E-learning can be briefly explained as learning and communication across computers and networks using a multitude of electronic sources (Eidson, 2009; Roffe, 2002; Wong, 2007, Sambrook, 2003) for which paper and personal contact is not necessary. E-learning is not a new concept and has been in existence for years. However e-learning has taken a turn to include not only distance education, but also using electronic devices for contact education. Utilising electronic devices in education, will reduce the demand for paper (textbooks, writing paper and printing paper) and therefore paper production which has a severe effect on the environment as reflected earlier. By reducing paper production and consumption, the waste production is also minimised as a result.

"An increasing number of companies are adopting e-learning, but in their rush to take advantage of e-learning's benefits and promises, companies are finding that there are significant barriers" (Simmons, 2002:19). Rogers (2000) suggests that the successful implementation of e-learning, depends on a behavioural adjustment in both the learner and instructor. The author will explore the barriers identified below.

The US has experienced exceptional growth in e-learning in the last few years and it seems like that growth is not slowing down in the foreseeable future (Edelson & Von Pittman, 2001). Research carried out in Louisville, Kentucky (Mungania, 2003) highlighted the following barriers:

Table 27: E-learning barriers identified in US (Mungania, 2003)

Barriers identified	Facilitators	Attitude	Infrastructure
Personal barriers, including a negative attitude, poor time-management, inadequate learning methods and language barrier		✓	
Instructional barriers, relating to material, course design, incompetent lecturer and no progress reports	✓		
Situational barriers, referring to the study time and study atmosphere		✓	
Organisational barriers, such as course availability, administration challenges, non-involvement of employees and weight-carrying credit of the course	✓		
Content suitability indicating the expectation of the student, applicability of the material, quality of the information and the type of assignments	✓		
Technological barriers, which include connectivity, lack of knowledge and training, no technical support and loss of electronic information.			✓

Research carried out in Australia by the Australian Institute for Social Research (2006) on the barriers to e-learning, investigated the barriers under three main headings, namely connectivity, capability and content. Firstly, connectivity refers to the software, hardware and internet connection required for full implementation and utilisation of e-learning. Secondly, capability refers to the physical ability of the teachers and students as well as the support structure for students. Lastly, the content refers to the quality of the learning material used by the students.

The following barriers were highlighted in this study (Australian Institute for Social Research, 2006):

Table 28: E-learning barriers identified in Australia (Australian Institute for Social Research, 2006)

Barriers identified	Facilitators	Attitude	Infrastructure
Connectivity The high costs of acquiring hardware and software	✓		
The required infrastructure is not available			✓
The layout and design of the platforms are not user-friendly	✓		
Capability The induction for teachers and students is not adequate	✓		
Lack of support for students	✓		
Lack of interaction, not only with teachers but with fellow students as well	✓		
Poor supportive culture		✓	
Content The subject content does not translate properly online	✓		

An extensive study conducted in Sweden, on the organisational culture relating to the barriers to the implementation of e-learning (Bashiruddin *et al*., 2010), reflects the following critical barriers:

Table 29: E-learning barriers identified in Sweden (Bashiruddin *et al*., 2010)

Barriers identified	Facilitators	Attitude	Infrastructure
Lack of support	✓		
Skills and knowledge development		✓	
Inadequate infrastructure			✓
Hardware and Software Challenges			✓
Design of Courses	✓		
Availability of Resources	✓		
Geographical Diversity		✓	
Organisational Culture		✓	

A recently established university in Saudi-Arabia, carried out research on the barriers towards e-learning by faculty members (Al Gamdi & Samarji, 2016) and found the following barriers to be of significance:

Table 30: E-learning barriers identified in Saudi Arabia (Al Gamdi & Samarji, 2016)

Barriers identified	Facilitators	Attitude	Infrastructure
Lack of Incentives	✓		
Poor quality of learning	✓		
Uncertainty		✓	
Not proficient in English		✓	
Poor leadership	✓		
Lack of training	✓		
Poor Internet access and networking			✓
Lack of Support	✓		
Poor Instructional design	✓		
No regulatory Policies	✓		
Hardware and Software availability			✓
Security issues on internet	✓		
Workload not manageable		✓	
Not enough time to develop e-courses		✓	

A study that considered the barriers to the development of e-learning at the Payame Noor University of Iran (Mohamadzadeh *et al*., 2012) came to the conclusion that the leading barriers are as follows:

Table 31: E-learning barriers identified in Iran (Mohamadzadeh *et al*., 2012)

Barriers identified	Facilitators	Attitude	Infrastructure
Lack of Support	✓		
Not proficient in English		✓	
Difficulty in accessing hardware			✓
Lack of Infrastructure			✓
Need for funding, but not getting the necessary support.	✓		

Schools and universities are not the only place where e-learning is utilised and implemented, but in corporate companies as well. In light of this, research was carried out to review the obstacles of successful e-learning deployment, in small and medium enterprises in Slovakia (Medárová *et al*., 2012). The results are reflected in the table below:

Table 32: E-learning barriers identified in Slovakia (Medárová *et al*., 2012)

Barriers identified	**Facilitators**	**Attitude**	**Infrastructure**
Conceptual Lack of understanding		✓	
Targets and systems not aligned	✓		
Organisational Poor planning	✓		
Poor Communication		✓	
Lack of Funding	✓		
Reduced control of the functions of the system	✓		
Skills are not applied in the workplace		✓	
Technical Availability of technology			✓
Hardware and Software			✓
Internet connectivity			✓
Quality of instructional media	✓		
Updates and support	✓		
Human factor Approach and tools available		✓	
Lack of knowledge		✓	
Insufficient involvement and effort		✓	
Poor communication		✓	
Lack of ICT and learning skills		✓	

As was explained in the above research, these barriers are not isolated, and in some way interrelated or lead to another (Medárová *et al*., 2012). Research carried out in Nigeria (Bugi, 2012), reflects the following barriers to the implementation of e-learning:

Table 33: E-learning barriers identified in Nigeria (Bugi, 2012)

Barriers identified	Facilitators	Attitude	Infrastructure
Lack of ICT and learning skills		✓	
Inadequate power supply			✓
Internet connectivity			✓
Inefficient service providers	✓		
High costs of hardware, software and internet connectivity	✓		
Lack of skill and knowledge		✓	

The Department of Education in Gauteng province in South Africa, implemented an e-learning initiative in January 2015, that aims to see the end of printed textbooks and convert the paper-based learning process to digital (Anon. 2014c). As with any environmentally friendly initiative, e-learning also presents several barriers (Khanna, 2013); these barriers (Khanna, 2013) were identified as:

Table 34: E-learning barriers identified in South Africa (Khanna, 2013)

Barriers identified	Facilitators	Attitude	Infrastructure
Lack of skill and experience to manage own learning		✓	
Resistance to change and failure to manage new initiatives		✓	
Failure to manage time and make time to study		✓	
Absence of striking, applicable and good quality e-learning	✓		
Lack of education about the potential of e-learning as well as the practice and implementation		✓	
Challenges relating to logistics such as internet connection, technical barriers, network coverage, IT support and bandwidth			✓

Another study done in South Africa on black students in higher education (Takalani, 2008), reflects that e-learning is faced with the following barriers:

Table 35: Further e-learning barriers identified in South Africa (Takalani, 2008)

Barriers identified	Facilitators	Attitude	Infrastructure
Lack of communication with the instructor		✓	
Fear of damaging the equipment, fear of technology and fear of trying to learn		✓	
Lack of technical skills		✓	
Limited resources	✓		
Inadequate support from instructor	✓		
Learners are not made aware of e-learning.		✓	

The table below will serve as an illustration of the leading barriers identified, which had an impact on the full implementation and deployment of e-learning:

Table 36: Leading Barriers to the Implementation of E-learning

	US	Aus	Saudi	Slov	Nig	Swed	Iran	S.A
Facilitators								
High Costs / Lack of Funding		✓		✓	✓		✓	
Lack of Support / Poor Communication	✓	✓	✓	✓		✓	✓	✓
Lack of available information		✓				✓		
Course design & material	✓	✓	✓	✓		✓		
Poor quality of learning	✓		✓	✓				✓
Lack of skilled workers	✓	✓	✓	✓	✓	✓		✓
Attitude								
Personal barriers	✓		✓	✓			✓	✓
Uncertainty / fear			✓	✓				✓
Infrastructure								
Lack of Infrastructure				✓	✓	✓	✓	
Internet Connectivity	✓	✓		✓	✓			✓
Inadequate Hardware & Software			✓	✓	✓	✓	✓	

The most prominent barrier identified, emanate from countries which identified lack of support/poor communication, lack of skilled workers and poor course design as the

main elements resulting in facilitators being the leading barrier. Other barriers relate to attitude and infrastructure.

4.2.2 CLOUD COMPUTING

Cloud computing may be a new concept for some, but is fast becoming a popular choice for many individuals and companies. Cloud computing has become the 'next big thing' (Wyld, 2010) in the computer realm, in that it allows companies and individuals to store their information in the cloud (over the internet), instead of on their hard drives (Griffith, 2013). In the implementation of cloud computing, the necessity for physical storage facilities, to house the paper printed for document retention, is reduced as well as paper waste, once the retention period has expired and the documents are destroyed. Instead of trucks transporting physical documents to facilities, as well as trucks travelling from one company to another shredding documents, which contribute towards air pollution, documents can be transferred and stored electronically.

For individuals who do not have any knowledge of information technology, especially the older generation, the concept of cloud computing might seem foreign, technical and more often than not, intimidating (Oleson, 2015). As identified by Murphy (2014), people fear what they don't know or understand. The most common sources of this anxiety are different understandings of what cloud computing means (Murphy, 2014). Without perhaps realising it, cloud computing is already all around us and integrated into large companies[2] and major social media platforms[3].

Despite the possible advantages of cloud computing, there are still some concerns raised. Research (Tweneboah-Koduah *et al*., 2014) suggests that the leading barriers relating to the implementation of cloud computing are:

[2] Apple iCloud, Dropbox, Google cloud, Samsung Cloud Base Station, Sony PS4 cloud, Xbox One Cloud and SoundCloud, to name but a few.
[3] Facebook, LinkedIn, WhatsApp, Skype etc.

Table 37: Cloud computing barriers identified by Tweneboah-Koduah *et al* (2014)

Barriers identified	Facilitators	Attitude	Infrastructure
Compromising security	✓		
Lack of privacy and trust		✓	
Internet connectivity			✓
Service availability			✓
Organisational preparedness	✓		
Inadequate regulatory framework	✓		
Lack of commitment by management		✓	
Lack of understanding and inadequate knowledge		✓	
High costs	✓		

In a global survey carried out by KPMG International (Matuszak & Lamoureux, 2012), the following barriers were identified as significant:

Table 38: Cloud computing barriers identified by KPMG (Matuszak & Lamoureux, 2012)

Barriers identified	Facilitators	Attitude	Infrastructure
Loss of control		✓	
Integration with existing infrastructure			✓
Privacy and Security of Data	✓		
Uncertainty		✓	
High Costs	✓		
Inadequate regulatory framework	✓		

The majority of the barriers identified in governmental cloud adoption and implementation, sprout from the belief that cloud computing is new, as well as the marketplace being underdeveloped (Sedaghat *et al*., 2011). Once again, belief is a subjective preceptor of a person, which relates to attitude. When relating to the adoption of cloud computing in business, reference has to be made to the research carried out on the adoption of cloud computing by small and medium enterprises in developing economies (Yeboah-Boateng & Essandoh, 2014). In this research the following barriers were raised as a concern:

Table 39: Cloud computing barriers identified by Yeboah-Boateng & Essandoh (2014)

Barriers identified	Facilitators	Attitude	Infrastructure
Lack of skilled workers		✓	
Internet connectivity			✓
Breach of privacy and security	✓		
Lack of trust		✓	
Integration with existing systems			✓
Inadequate support	✓		
Resistance to change		✓	
Trialability of cloud computing	✓		
Lack of IT infrastructure and resources			✓
Compatibility with existing system			✓
Selecting a competent service provider		✓	
Loss of control		✓	

Research carried out in Europe (Cattaneo, 2012), shows that the barriers posed to the implementation of cloud computing, relate mainly to uncertainty as well as the following:

Table 40: Cloud computing barriers identified in Europe (Cattaneo, 2012)

Barriers identified	Facilitators	Attitude	Infrastructure
Security and data safeguards	✓		
Trustworthiness of the cloud			
Fear of not knowing where the information is stored (location)		✓	
Lack of local support	✓		
Change control	✓		

Jelonek (2014) has identified numerous mental barriers in research carried out in Poland (Jelonek *et al*., 2014) relating to implementation of cloud computing. These are the barriers the research highlighted:

Table 41: Cloud computing barriers identified in Poland (Jelonek et al., 2014)

Barriers identified	Facilitators	Attitude	Infrastructure
Legal jurisdiction	✓		
Security and privacy of data	✓		
Lack of trust		✓	
Data access and portability	✓		
Location of data storage	✓		
Inadequate support	✓		
Integration with current infrastructure			✓
Uncertainty		✓	
Lack of knowledge		✓	

In China, research conducted (To *et al*., 2013) reflects the following key barriers:

Table 42: Cloud computing barriers identified in China (To *et al*., 2013)

Barriers identified	Facilitators	Attitude	Infrastructure
The Great Firewall, which is the country's firewall, which may automatically block learning content perceived as a risk	✓		
Privacy and Security	✓		
Lack of Infrastructure			✓

Resistance will be portrayed towards cloud computing, as expressed by Mzekandaba (2014), who is of the opinion, that the leading barrier to cloud services adoption is a concern over security. According to Nkosi Kumalo from Vodacom Business (as cited by Mzekandaba, 2014), 32% of South African companies have security concerns relating to the implementation of cloud solutions. The table below reflects the leading barriers which were identified by the studies researched by the author, some of which will reflect the country and some the author. Those studies which reflect the author are not geographically bound and were done on an international level.

Table 43: Leading Barriers to the Implementation of Cloud Computing

	T-K	KPMG	Sedaghat	Y-B&E	Eur	Pol	China	S.A
Facilitators								
Lack of support				✓	✓	✓		
Attitude								
Lack of trust	✓			✓	✓	✓		
Loss of control		✓		✓		✓	✓	
Uncertainty / fear	✓	✓	✓	✓	✓	✓		
Lack of Preparedness & False Perceptions	✓		✓				✓	
Security concerns	✓	✓		✓	✓	✓	✓	✓
Infrastructure								
Trouble Integrating with current system		✓		✓	✓	✓		

The leading barrier identified is attitude with elements such as uncertainty/fear and safety concerns being highlighted. Less significant elements contributing to the barriers relate to lack of trust, loss of control and integration with the current system.

4. ANALYSIS OF THE RESULTS

From the literature review several barriers were identified which inhibit the full implementation or adoption of a particular environmentally friendly technology. The author identified the similarities in the results obtained from all the technologies researched and highlighted the leading barriers acknowledged. Analysing the barriers identified in the studies sampled, there is a definite trend visible in the adoption, integration and implementation of environmentally friendly technologies. The table below details the leading barriers identified in the sample studies of each environmentally friendly technology observed in this research:

Table 44: Leading Barriers to the Implementation of Environmentally Friendly Technologies

	Renewable energy	**Electric vehicles**	**Sust building**	**e-learning**	**Cloud computing**
	Environmentally friendly technologies			*Waste reducing environmentally friendly technologies*	
Facilitators					
High costs / Lack of funding	✓	✓	✓	✓	
Lack of skilled workers	✓	✓	✓	✓	
Lack of governmental support	✓	✓	✓		
Lack of available information	✓	✓	✓		✓
Inadequate Regulatory framework			✓		
Attitude					
Uncertainty / fear	✓	✓	✓	✓	✓
Lack of awareness	✓		✓	✓	
Infrastructure					
Lack of infrastructure	✓	✓		✓	

The only element which was raised as part of a leading barrier in all the environmentally technologies reviewed in this study, relates to uncertainty and fear, which fall under

attitude. From the information above, it is evident that the leading barriers identified, relate primarily to facilitators and attitude.

Of the barriers identified, it is evident that people's perception and knowledge are vital elements to the attitude barrier presented in the implementation of environmentally friendly technologies. Furthermore, high costs, lack of funding, lack of skilled workers as well as a lack of available information all emanate under the facilitators heading, which is quite concerning, since human perception is not the only factor which has to be focused on in encouraging change, but also the structure as well as the infrastructure supporting the technology.

4.3 EXPLORING HOW THE BARRIERS IDENTIFIED, AFFECTS ELECTRONIC SIGNATURES

Several environmentally friendly technologies have been considered in this study. Firstly the author analysed environmentally friendly technologies which promote sustainable consumption and thereafter considered the environmentally friendly technologies that specifically aim to reduce waste and in doing so encourage sustainability.

In this study it has emerged that the majority of the leading barriers relate to facilitators which refer to elements such as high costs / lack of funding, lack of skilled workers, lack of governmental support, lack of available information, inadequate regulatory framework as well as to attitude, which encompass elements such as the lack of awareness and uncertainty/fear. Although infrastructure plays a definite role, it appears that infrastructure is less of a concern than the other barriers identified. Studies reveal that there is a definite link between *"a consumer's sense of environmental responsibility and their environmentally related consumption behaviours"* (Wells, *et al*. 2011). As reflected in the barriers, attitude could be a role player in the barriers to the uptake of electronic signatures. This is an element, over which we have direct control and which can be changed much easier than facilitators or infrastructure. Therefore educating citizens seems like a vital initial step to change negative attitudes that have an impact on the

environment (Alavosius & Newsome, 2012) and therefore create a shift towards environmentally friendly behaviour.

Much like any other change, technological changes require a mind-shift as well as an attitude adjustment towards such changes (Reed, 2014). Green initiatives and environmentally friendly technologies are frequently met with excitement on the one hand, but also hesitation, criticism and cynicism on the other (Simpson, 2015; Murphy, 2014). This, as often seen in our own work environments, could be the result of fear: a fear of change (Connelly, 2009), a fear of failure or a fear of the unknown (Murphy, 2014). Also expressed by Lovecraft (1973:1), *"the oldest and strongest emotion of mankind is fear, and the oldest and strongest kind of fear is fear of the unknown".* If people in companies are unaware or unfamiliar with a certain technology, it is likely that emotions such as fear will set in and influence the decision-making process to implement such a technology. This can have a severe impact on the growth and implementation of environmentally friendly or any other such new technology.

With regards to the facilitators presenting itself as a leading barrier, it is noteworthy that the government is instrumental and has a strong-arm approach, which has the ability to cripple any environmentally friendly initiative, simply through opposition or a lack of support from government. There are a few factors of government which may influence this, such as a lack of subsidies and regulatory frameworks (legislation, codes, standards and regulations) as well as the promotion of a political agenda (for instance receiving a rebate on the oil consumed in the country or boosting another initiative to gain votes from the public), as identified in the literature review above. Furthermore, in the current economic climate, money is a definite factor that is taken into account in all decision-making, which is evident with high costs being identified in nearly all the studies researched.

The results of the studies examined, as well as the statements made by Rootshtain *et al*., (2014), were utilised in structuring the barrier options for selection in the questionnaire. These options encompass all the leading barriers identified, such as high costs/lack of funding, lack of governmental support, lack of available information, inadequate regulatory framework, uncertainty/fear, lack of awareness and a lack of infrastructure. The table below illustrates how the barriers identified were utilised to

draft the questionnaire as well as (in addition to the research aim) which research question it relates to.

Table 45: Guidance in drafting the questionnaire and addressing research questions

Barrier identified in Literature Review	Linked to question in questionnaire	Relates to research question
Facilitators		
High costs / Lack of funding	Implementation and switching to digital will cost too much. We don't have the budget.	2
Inadequate Regulatory framework	Electronic signing is not a legal requirement. There is no legislation compelling us.	2
	The documents we sign are excluded by the ECT Act and may not be signed electronically.	2
Lack of governmental support	Electronic signing is not a legal requirement. There is no legislation compelling us.	2
Attitude		
Lack of awareness	Are you aware that Section 13 of the Electronic Communications and Transactions Act authorises you to sign the majority of agreements electronically?	1,2
	I am not familiar with electronic signing. Lack of knowledge on electronic signatures.	1,2
Uncertainty / fear / lack of trust	We don't trust the technology and are concerned about document security and confidentiality.	1,2
Uncertainty / fear	We are used to paper-based signing & don't want to change.	2
Infrastructure		
Lack of infrastructure	Do you have access to a PC, laptop, smartphone or tablet/iPad?	2

CHAPTER 5: BARRIERS TO THE UPTAKE OF ELECTRONIC SIGNATURES

As previously discussed, the interviews were conducted with professionals within the digital signature industry, to gain an understanding from a service provider's point of view. The questionnaire results will be utilised to shed light on the barriers experienced from the consumer's point of view. The results of both the interviews and questionnaire will be discussed below.

5.1 RESULTS FROM QUESTIONNAIRE

The link to the website, created to host the electronic questionnaire for the purposes of this research, was sent to 350 senior management recipients via email, Facebook, LinkedIn and WhatsApp. From the above, a total of 101 participants responded and completed the questionnaire, which is a response rate of 28,8%. The figures below will illustrate the number of participants according to age as well as the industry of the participants. The author targeted predominantly senior personnel and management staff from companies, which may account for the 48% of participants being between the ages of 30 and 39 years.

The reason for including age, stems from the seminar presented by ARX and Microsoft (Rootshtain *et al*., 2014), as well as the interviews conducted with industry professionals, identifying age as a crucial factor in the barriers presented in their research.

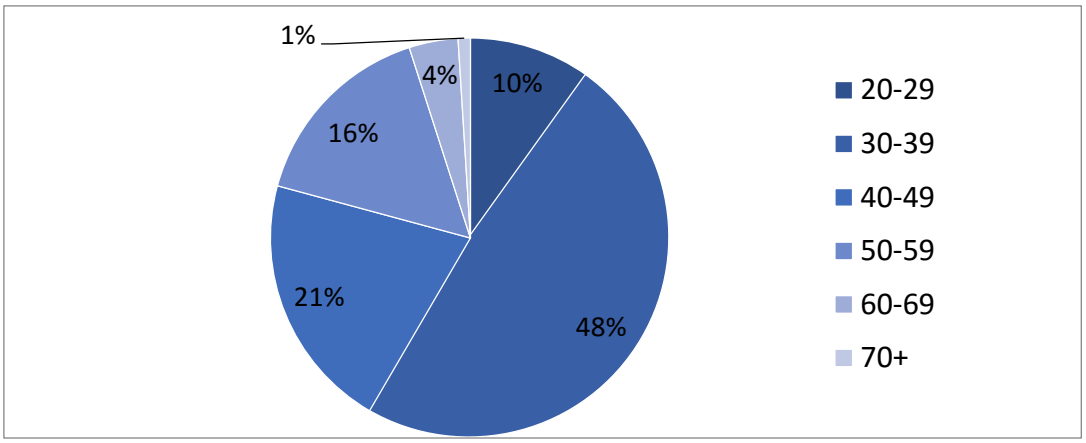


Figure 6: Age of participants to the questionnaire

In an attempt to establish a wide angle on the barriers experienced, the author included a heterogeneous selection of industries. At least two representatives from each of the industries listed below completed the questionnaire. The majority of participants represented the legal/judicial, IT/telecommunications and financial services industries. The author experienced resistance from government employees, as a result of secrecy and non-disclosure required by the state departments. The industries listed as other, contained participants from various industries including but not limited to sports associations, service providers, security, food and office automation. Figure 7 depicts the industries that took part in the questionnaire as well as the number of participants within each industry.

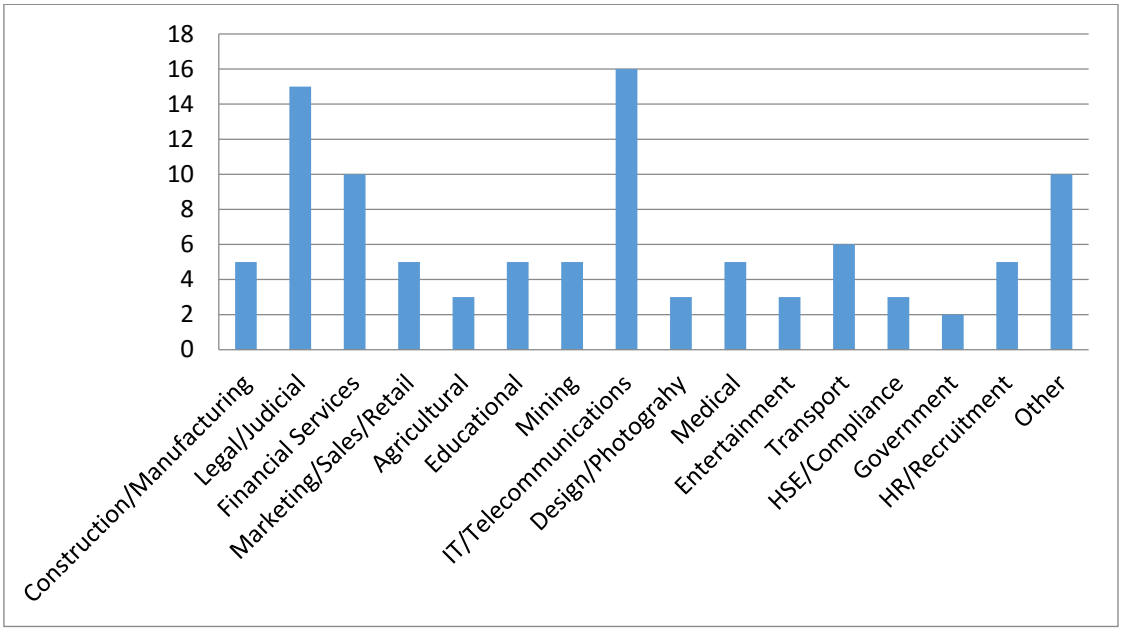
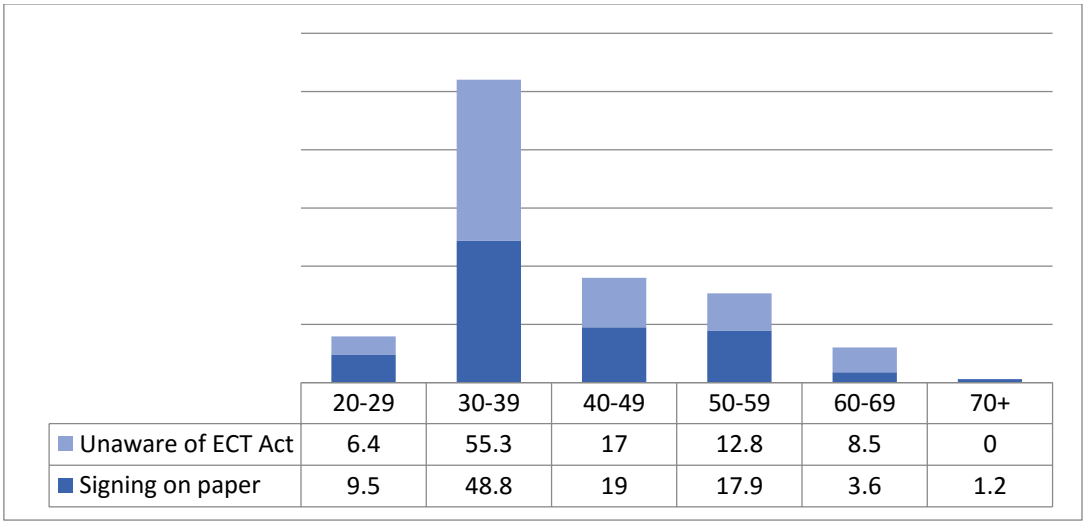


Figure 7: Industries, participants to the questionnaire, work in

The remainder of the data retrieved from the completion of the questionnaire, related to awareness of the ECT Act, printing documents for signature and utilising electronic signatures. From the information retrieved from the questionnaires, it is evident that all of the participants have regular access to a computer, laptop, tablet or smartphone, all of which can be utilised to generate a digital signature. The access to the basic infrastructure such as computers and smartphones, should therefore not pose a challenge in implementing electronic signatures within organisations.

The author made specific reference to section 13 of the ECT Act (which enables the use of electronic signatures on documents in South Africa), to determine whether the participants are aware of the existence of this provision as well as answer research question 1. As reflected in the literature review, not having knowledge and insight to a certain aspect can pose a critical barrier. The results reflect that 46.5% of the participants are not aware of section 13 of the ECT Act. From this percentage, it can be deduced that nearly half of the participants do not have knowledge of the one piece of legislation enabling electronic signing and are oblivious to the provisions that have been implemented to acknowledge electronic signing. As can be expected, of the 53.5% of participants indicating that they are aware of the ECT Act, 22.2% originated from the legal/judicial industry. To answer research question 1, the author investigated the correlation between the awareness of participants to signing on paper. The figure below yields the results.



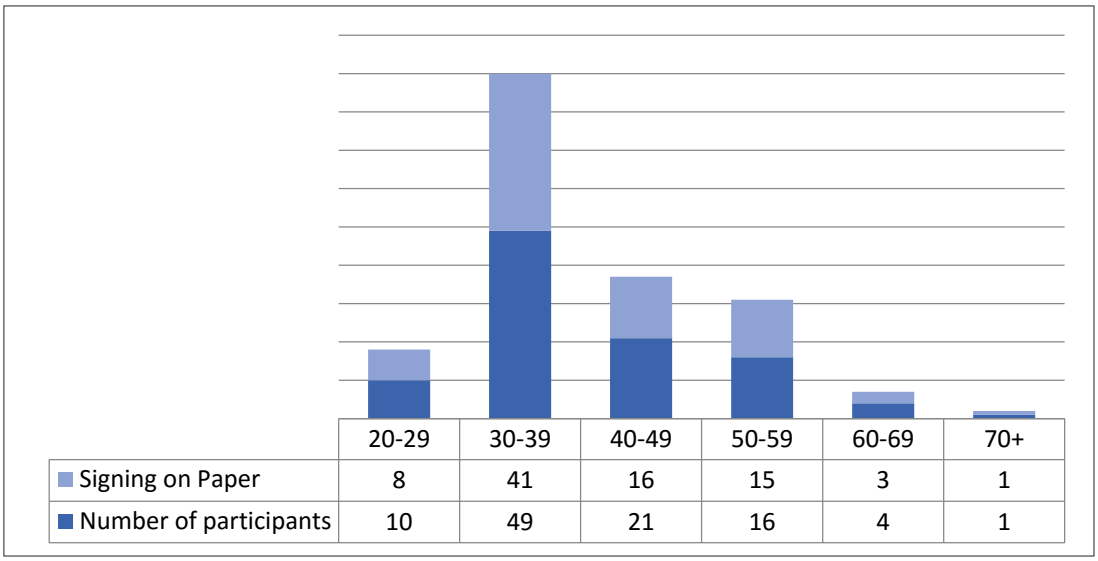
	20-29	30-39	40-49	50-59	60-69	70+
Unaware of ECT Act	6.4	55.3	17	12.8	8.5	0
Signing on paper	9.5	48.8	19	17.9	3.6	1.2

Figure 8: Ratio between signing on paper and awareness of ECT Act

From the figure above, it appears that unawareness of the ECT Act and signing on paper run parallel with one another, which indicates that a lack of awareness may definitely be a factor to consider in the uptake of electronic signatures.

A total of 83.2% of participants print documents in order to affix a manuscript signature thereto. From the results, 29.7% of the participants indicated that they also make use of electronic signing, therefore using both manuscript and electronic signatures to sign, which leaves only 16.8% of participants who do not print documents for signature and

sign exclusively with electronic signatures. Of the participants utilising manuscript and electronic signatures, 83.3% indicated that they prefer paper-based signing to electronic signing. The reason for the preference is however, unclear. An overwhelming 53.5% of participants indicated that they sign exclusively on paper, using manuscript signatures. The results were broken down further into age to verify whether age is a relevant factor in the transition to environmentally friendly technologies and specifically electronic signing. The figure below illustrates the ratio between the ages of participants, printing documents to sign, to the total participants as per the age group.



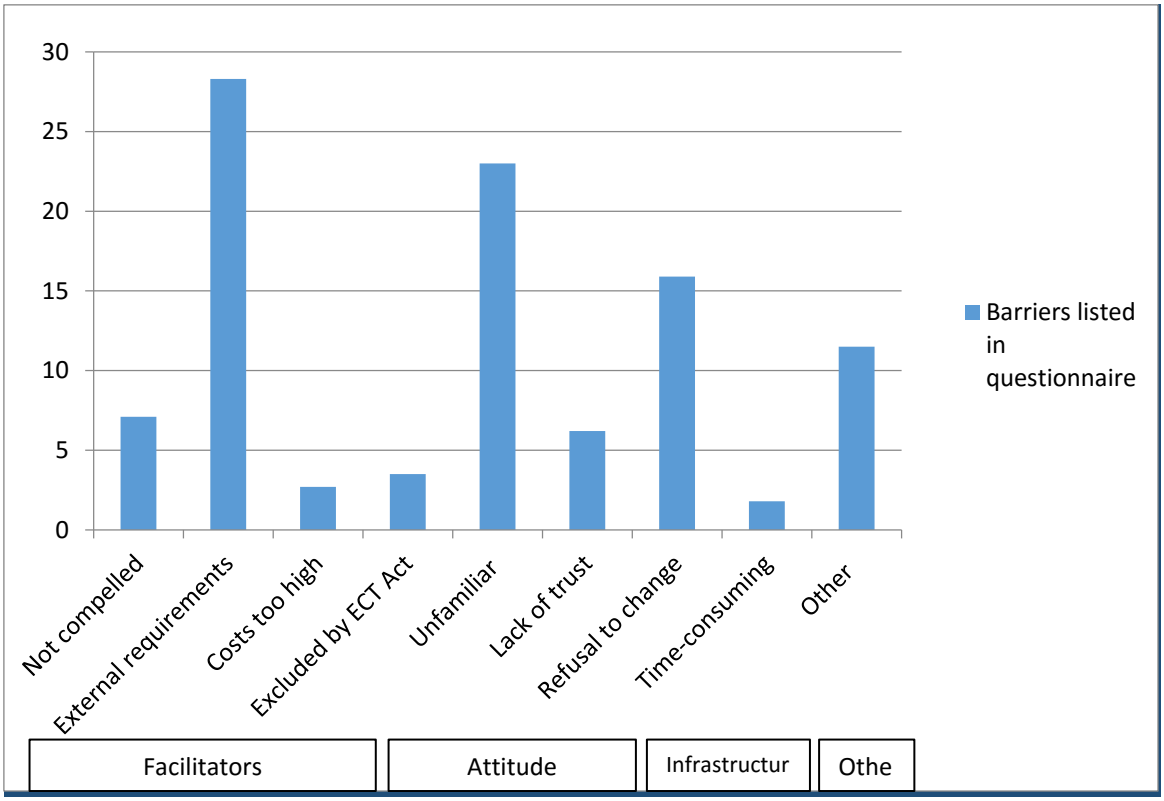
	20-29	30-39	40-49	50-59	60-69	70+
Signing on Paper	8	41	16	15	3	1
Number of participants	10	49	21	16	4	1

Figure 9: Ratio between signing on paper and age

The figure above illustrates that the number of participants according to age correlate closely to the number of participants signing on paper. The figure displays no spike in a specific age group that signs on paper, which indicates that age is not a major factor in the resistance to the uptake of electronic signatures.

Those participants, who indicated that they print documents in order to sign, using manuscript signatures, were requested to identify the barriers for not utilising electronic signatures. In addition to the listed barriers, the participants had the option to identify any other barrier which they might have experienced, which were not listed in the barrier options provided. The listed barriers identified by the participants to the questionnaire, are listed below, together with the percentage of participants who selected the particular barrier.

Table 46: Barriers to the uptake of electronic signatures identified in questionnaire



Besides the fact that companies have to comply with external organisations' requirements, there seems to be other factors that also play a major role in the resistance to the conversion from paper to digital. As mentioned earlier in this study, uncertainty plays the largest role in the implementation of environmentally friendly technologies, which also extends to electronic signatures. Both of the other two major barriers, relate to attitude; 23% of participants view a lack of knowledge and unfamiliarity as a barrier, whereas 15.9% print paper out of habit and do not want to change. This confirms the barriers identified during the Microsoft Seminar (Rootshtain *et al*., 2014), as well as answer research question 1 and 2. Furthermore, the results confirm the necessity for a mind-shift towards digital technology.

The other barriers identified by the participants on their own accord (11.5%), which were not listed as options, relate to the following:

- The necessity to retain physical copies of documents;
- Compliance with internal company policies;
- Printing documents out of habit;

- Concerns over other contracting parties/institutions not accepting electronic signatures;
- Companies do not have the necessary software and hardware;
- Certain legislation demand paper-based signed documents, which have to be kept for an extended period or even indefinitely, such as court documents.

The participants who print documents in order to affix a signature, indicated the average set of copies printed for that purpose, which is contained in Figure 10 below. The majority of participants, on average, print two sets of documents to affix a signature. In the author's experience, companies often request that documents be signed in duplicate for purposes of document retention and compliance with internal company policies. By printing documents for signature, paper waste increases instead of being minimised, as envisaged by the NWMS (DEA, 2011).

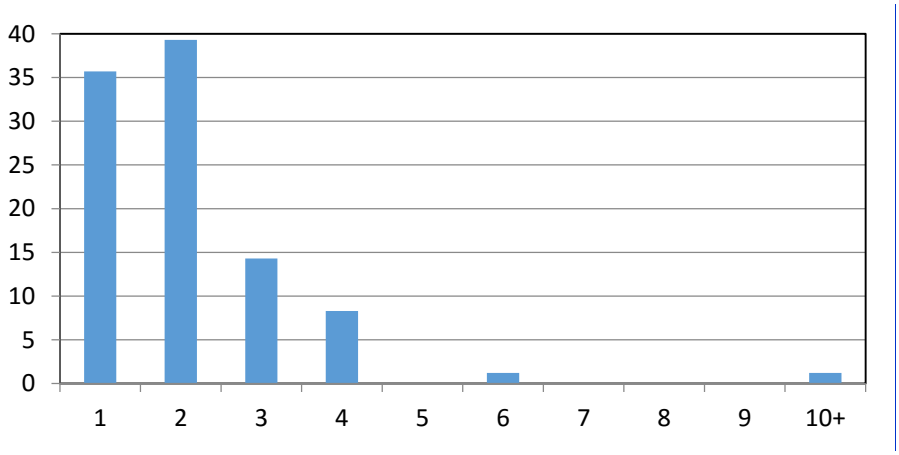


Figure 10: Average number of documents printed for signature

5.2 RESULTS FROM INTERVIEWS

The interviews were semi-structured, to allow the interviewees the opportunity to elaborate on their own experience and provide an unguided view of the type of barriers (Harvey, 2015), if any, which they experience with the uptake of electronic signatures and the conversion from manuscript signatures to electronic signatures. All of the individuals interviewed, are in the digital signature industry and have experience in and knowledge of digital signature solutions, as well as the application thereof in the South African market. The question of whether barriers exist to the implementation of

electronic signatures, was posed and an opportunity was granted for the interviewees to expand on the barriers they experience. The results from the interviews contribute greatly in gaining an understanding of the experience from a service provider's point of view.

Interview with Strydom:

Strydom (2015) states that *"there is a perception that it's not safe, that is the biggest problem…people are scared, especially the old-school*". The older generation is generally accustomed to sign documents on paper and still trust the "black on white" principle, which relates to a contract only being a valid contract once there is a signature in ink on printed paper.

When referring to security, it doesn't refer to security in the sense of loss of data or breach of information, it refers more to the feeling of security, as Strydom (2015) stated "*we have never had an issue with that, it is more the security that legislation will cover you when something goes wrong*". Another challenge is that "*we are a third world country and not everyone has access to the internet and computers*" (Strydom, 2015). Strydom (2015) went further by saying that there are industries and legislative provisions that require certain formalities that hamper the uptake of electronic signatures.

Interview with Van Der Merwe:

Van der Merwe (2015) discussed the barriers experienced in saying that "*the legal industry and the auditing industry, are two industries that are very conservative in their thought process, so that conservativeness is something that slows the process down*". Age was furthermore a factor that plays a vital role in that "*most of those companies are now run by the previous generation, that are not digitally orientated, but as the new generation enters and you can also see a lot of the new law firms with new generation, they adapt very quickly and like things that work quickly"* (Van der Merwe, 2015). This shift towards digital signatures will not happen overnight, it is like *"chiseling away at a brick with a toothpick"* (Van der Merwe, 2015). Van der Merwe proceeds by saying that *"there is a whole legal system controlled by the courts, and regulations…to adapt that, will not be a quick process and will take time*". The whole system will have to change

and adapt, not only one company or one industry. Some industries are not ready for this yet, even though they know it has to happen (Van der Merwe, 2015).

Van der Merwe (2015) further commented that the younger generation that grew up with cellphones, iPads and other technological advancements, are much more receptive to the idea of change and implementation of environmental friendly technologies such as electronic signatures. The author was informed by Van der Merwe (2015) of a case study carried out in a company on documents printed according to age category. What they found was that the younger generation prints less because they are used to reading on their screens "*and that the younger generation will be the generation that uses digital signatures*" (Van Der Merwe, 2015). According to Van der Merwe (2015), a transformation will be visible once there has been a change in culture and mind-set.

Interview with Moyle:

Moyle (2015) suggests that the basic legal framework in support of the enforceability of electronic signatures, to encourage wide implementation and trust amongst companies and users, is lacking. Clients often pose questions such as "*can we really rely on the signature that we get and the basic legal framework supporting the enforceability of it*" (Moyle, 2015). Moyle (2015) also states that "*there is a lot of fear on the part of those who want to start the process and a lot of concern of whether the signatories will accept it, and they almost always overestimate the amount of resistance that they will get*". In relation to technology "*people will say our customers are conservative, they're old and don't know how to do this, they're afraid of technology and the fact is that the people we are talking to are afraid of technology*" (Moyle, 2015).

When asked whether age plays a role, Moyle (2015) responded by saying that "y*ou'll find there is definitely a curve with age, but I don't think its age that causes it, I think it's just the tendency in folks that are younger - their exposure to rapidly changing technologies is just greater and they are far more willing to experiment with things and accept ways of doing things that they have never heard of*".

Moyle (2015) further expands on this by saying that "*people are still afraid to take this step and part of this is really a very human concern about, attributing to a very age-old process, a lot of validity and proof and transparency that it actually never had in the first place…which is actually just a visceral response to change*".

The challenge according to Moyle (2015), is often found "*in government and highly regulated industries*", which are concerned with "*formalities for formalities' sake in compliance, so it's hard to take a business judgment decision or business risk decisions, because you are going to be second-guessed by a regulator or inspector or an auditor, who may not agree with your take on it, so a lot of the times they are waiting for everything downstream to be perfect before they try it*."

The table below illustrates the barriers identified by each interviewee.

Table 47: Barriers to the uptake of electronic signatures identified in interviews

Barrier identified	Strydom	Van Der Merwe	Moyle
Facilitators			
Regulated industries (formalities)	✓		✓
Attitude			
Conservative thought process (age)	✓	✓	
False perceptions by consumers	✓	✓	✓
Uncertainty and fear of change	✓	✓	✓

Even though there was free reign on the manner in which the responses were provided to the questions, a strikingly similar pattern manifested itself with all of the interviewees. Although certain barriers are exclusive to a company or area, all of the responses reflect that people's uncertainty and fear of change as well as people having false perceptions about electronic signatures, appear to present the leading and most cumbersome barriers to the uptake of electronic signatures. These findings confirm the author's hypothesis. Furthermore, the results revealed that the fear or refusal to change is attributed to the fact that people are unaware and uninformed of electronic signatures and have misperceptions in that regard. Due to the unknown, people are distrustful and apprehensive towards electronic signatures, as well as the application and repercussions thereof. Although Van der Merwe (2015) and Strydom (2015) identified age as a barrier, the questionnaire results reflect that signing on paper relates less to age and more to a lack of awareness. Therefore, even though age may play a deciding factor in the knowledge and awareness of consumers, it appears that age is not a standalone barrier. The results presented in the questionnaire and interviews satisfy and answer the research aim, research question 1 as well as research question 2.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

Although this study might not represent the whole of South Africa, due the different levels in education and environmental awareness, it does however offer a useful understanding of the perceptions and behaviour of organisations towards an environmentally friendly technology. Considered to be one of the most polluting industries in the world, the pulp and paper industry has a severe impact on the environment, which through reduction in paper, can be minimised to an extent. Having had the legislation permitting and regulating electronic signing since 2002, this study reflects that 46.5% of people are unaware of the provisions of that legislation. The ratio between the people signing on paper and the lack of awareness correspond largely, which answers research question 1 as well as confirm the author's hypothesis. Although waste reduction is the number one goal of the NWMS, 83.2% of companies still print documents in order to sign, which creates a large amount of paper waste.

Facilitators, attitude and infrastructure were utilised as the headings for the barriers identified in the literature and throughout this research to align the methodology. The main barriers identified in the implementation of environmentally friendly technologies relate to the following. The barriers in red correspond to the barriers to the uptake of electronic signatures.

Facilitators

- High costs
- Lack of skilled workers
- Lack of governmental support – no subsidies are offered and certain governmental departments demand paper-based signed documents
- Lack of available information – links to a lack of awareness and false perception that consumers have about electronic signatures
- Inadequate regulatory framework

Attitude

- Uncertainty / fear
- Lack of awareness

Infrastructure

- Lack of infrastructure

The leading barriers to the uptake of electronic signatures identified by consumers in the questionnaire relate to companies having to comply with external organisations' requirements (facilitator), a lack of knowledge and unfamiliarity as well as printing out of habit and refusal to change (attitude). The leading barriers relating to the uptake of electronic signatures identified by service providers during the interviews, relate to the formalities as regulated by industries (facilitator), conservative thought process, which is influenced by age, a false perceptions by consumers, uncertainty and fear of change (attitude). As was reflected in the results, although the service providers identified age to play a role in the uptake of electronic signatures, the questionnaire results contradict the views of the service providers. The questionnaire results show that signing on paper relates less to age and more to a lack of awareness. The research aim was attained by answering research question 1 and 2 as well as from the conclusions above. Each leading barrier will be addressed individually with recommendations below.

Facilitator – Companies have to comply with external organisations' requirements / Formalities as regulated by industries

As mentioned by Moyle (2015) *"it's hard to take a business judgment decision or business risk decisions, because you are going to be second-guessed by a regulator or inspector or an auditor, who may not agree with your take on it, so a lot of the times they are waiting for everything downstream to be perfect before they try it*." Therefore, several companies do want to implement electronic signatures, but is held back by other companies demanding paper-based signatures. Large corporations in each industry should in collaboration with government therefore implement electronic signatures in order for the smaller companies to follow. Zyadin *et al*., (2014) suggest that adequate plans which promote the involvement by government in creating supportive policies can encourage companies to be more receptive to the idea of environmentally friendly technologies and especially electronic signatures. These policies drafted should strive to be fair, transparent, positive, encouraging and co-operative (Allen *et al*., 2012).

Attitude - A lack of knowledge and unfamiliarity / Uncertainty

By identifying attitude as a barrier, transformation towards implementation and acceptance of environmentally friendly technologies and in particular electronic signatures, can be strongly influenced (Hoffman & Henn, 2008). In order to cultivate a pro-environmental attitude and improve sustainability, Hargreaves (2011:96) suggests that the "*conventional narrow models of individual behaviour change may need to be abandoned*" and replaced with a "*greater research and policy attention to the complex task of generating more sustainable practices*". As identified, uncertainty plays a vital role in the attitude towards new technologies and decision-making. To overcome the uncertainty element, several studies recommend that effective communication can enhance the introduction and implementation of environmentally friendly technologies - whether it's between government and the community, investors and the public or implementers and consumers (Alavosius & Newsome, 2012; Hart, 2009; Al-Mansour & Pusnik, 2014; Egbue & Long, 2012). Collaboration between government, industries, implementers, investors and consumers is necessary in promoting and improving communication, education and the availability of information to advance the level of knowledge of South African citizens and in so doing, encourage participation and sound decision-making. Communication is an important aspect to consider, as it would address the majority of the barriers identified in this research. Communication will include awareness campaigns, information sessions, training, education of all stakeholders, making information readily available, actively participating in communities, interacting with the general public and perhaps making available prototypes or samples of the technologies for people to try out.

Attitude – Habitual printing and refusal to change / Conservative thought process and fear of change

In order to create a mind-shift within society and encourage the uptake of electronic signatures, an advocate, who took part in the questionnaire, recommended the amendment of certain legislation that still requires manuscript signatures. Furthermore, internal policies and encouragement from management will be necessary to encourage and promote implementation. Sustainability, as envisaged in NEMA (South Africa,

1998), should at all times be kept in mind and integrated into the overall environmental management strategy. This will naturally incorporate the reduction of waste and preservation of the environment. With the rate of environmental degradation, mindless applications and thoughtless conduct can no longer be overlooked – all actions have reactions, which may either be positive or negative to the environment, which is why a mind-shift towards sustainable actions is vital for environmental conservation.

The participants in the questionnaire were prompted to articulate their own recommendations to promote and improve the uptake of electronic signatures. The majority of recommendations relate to the following:

- Creating awareness in companies, auditing industry, general public and government;
- Improved education and training to become more informed and knowledgeable on the subject;
- A clearer explanation of the practical application and integration of electronic signatures with devices;
- Training and effective communication relating to legislation governing electronic signatures;
- Security risks need to be addressed, which will include validation and authentication of parties;
- Simplifying electronic signing for individuals with limited computer literacy;
- Implement mandatory regulations to establish common practice;
- Companies need to promote electronic signing internally through implementation, policies and procedures as well as training and awareness;
- Universal acceptance by other law firms or entities which would justify the need for electronically signed documents;
- Amendment of legislation and court rules, which require paper-based, signed and original copies.

The recommendations made by the participants to the questionnaire relate to the listed barriers in Table 47 as well as the other barriers identified by the participants themselves. An analysis of the recommendations made by the participants to the questionnaire, clearly indicates a misunderstanding of the application, risks and integration of digital signature solutions in existing systems and devices, which confirms

the author's hypothesis. As a basis, extensive educational programmes, awareness campaigns and internal training are required to educate and inform society of the legality, application and integration of digital signatures. Once the level of knowledge is increased to an acceptable standard, companies can commence with introduction and implementation to drive paperless policies. Wide application will depend largely on how wide industry acceptance and implementation stretch.

ANNEXURES

ANNEXURE A STRUCTURE OF QUESTIONNAIRE

The entire questionnaire was operated and managed electronically. The participant could access the questionnaire by clicking on a link provided, which would direct the participant directly to the online questionnaire. The results were automatically calculated to ensure accuracy and avoid human error. The questionnaire commenced with a short introduction explaining the purpose and objectives as well as a statement to inform the participant that personal information obtained will be kept confidential and will not be disclosed in the research document.

The following information was required to be provided by the participant, before continuing with the completion of the questionnaire:

- Name and surname, company, age, industry and appointment (designation)

This information was utilised to ensure that one participant does not complete the questionnaire more than once as well as to establish whether the results are industry- or age-specific.

The following questions were posed, one by one and provided a drop-down menu with possible answers to choose from:

Question 1: Do you have access to a PC, laptop, smartphone or tablet/iPad?

Question 2: Are you aware that Section 13 of the Electronic Communications and Transactions Act authorises you to sign the majority of agreements electronically?

Question 3: Do you print documents in order to sign it?

Question 4: If answered yes, is there a reason why you print documents to sign instead of signing the documents electronically?

Possible answers:

- Electronic signing is not a legal requirement. There is no legislation compelling us.

- We are used to paper-based signing and don't want to change.
- I am not familiar with electronic signing. Lack of knowledge on electronic signatures.
- Implementation and switching to digital will cost too much. We don't have the budget.
- We don't trust the technology and are concerned about document security and confidentiality.
- Our company has to comply with the standards set by our customers/suppliers/auditors/governing body in that documents have to be signed using paper-based signatures.
- The process is too complicated and time-consuming.
- The documents we sign are excluded by the ECT Act and may not be signed electronically.
- Other (please specify) – participants can identify any barriers of their own here

If answered no, the participant will be automatically directed to question 5 and question 4 will not appear.

Question 5: Do you sign documents electronically?

Question 6: If the answer to question 3 and question 5 were both yes (will redirect the participant automatically), which do you use more often, paper-based or electronic signatures? If one of the answers were no, this question will not appear.

Question 7: On average how many sets of copies are made in order to obtain a set of signatures on a single document? If the answer in question 3 was no, this question will not appear.

Question 8: What recommendations do you have to overcome the barriers identified in answer 4?

ANNEXURE B INTERVIEWEES AND INTERVIEW QUESTIONS

The author conducted interviews with the following people:

- Leon Van Der Merwe, Business Development Manager at Pitney Bowes (PB Verify), South Africa;
- Ken Moyle, Chief Policy Officer at DocuSign, International;
- Hendrik Strydom, former CTO at JMR and developer of Eezi-sign, South Africa.

All of the interviewees signed a release form in order for the author to utilise their names for purposes of this research.

The interviewees were asked to provide their professional opinions and views based on experience with digital signatures, on the following questions:

1. Are people very receptive to the idea of electronic or digital signatures?
2. In your experience do companies show any reluctance to implement electronic signatures and replace paper with a digital initiative?
3. What are the barriers you have been faced with?
4. Do you have any recommendations or ideas on how to overcome these barriers?

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