An Innovative Approach to the Regulation of Equipment Authorisation in Developing Countries: A grounded theory study of South Africa

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A thesis submitted to the Faculty of Humanities,

University of the Witwatersrand, Johannesburg,

in partial fulfilment of the requirements for the degree of

Doctor of Philosophy in Interdisciplinary Digital Knowledge Economy Studies

2017

Abstract

The current theoretical approach to equipment authorisation (EA) regulation has proven problematic to resource-poor countries. EA is the technical and administrative process that all electronic communications equipment are subject to before sale and use. EA involves checking the technical characteristics of equipment, by dedicated test facilities, to national or international standards which are enforced by the regulatory authority. Initial research in the South African EA environment has revealed several real-world trends that show that the current approach to EA regulation has limitations when faced with a changing electronic communications (EC) landscape.

The general theories of public interest and the economic theory of regulation only broadly form the theoretical basis for EA regulation. The narrow focus of the thesis in developing an innovative approach to EA regulation, in the context of a developing country, required seeing beyond the existing theory surveyed in the literature. Using a Straussian approach to grounded theory, the epistemology of the EA environment is studied inductively via a post-modernistic interpretative framework. The research finds that the EA framework, applicable to efficiency driven and transitional countries with a relatively rich EA testing infrastructure, is predicated on a calculated concept of trust. The regulatory authority employs a tacit computational mechanism to determine the level of trust when dealing with EA applications. The rationale for such an approach is largely driven by sub-optimal decision heuristics available to the regulator, as a result of an inability to corroborate technical data associated with the EA process. The regulator thus applies a differential trust paradigm based on determining factors such as salience.

A future knowledge-based approach to EA regulation is theorised, in which technology innovation assimilated from other EA environments, is applied to the EA process to improve

institutional efficiency. The goal of applying technology and innovation to the EA process is ultimately centred around increasing the trust value proposition.

Declaration

I, Praneel Haricharan Ruplal, hereby declare that this thesis is my own, unaided work. It is submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in any other university.

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Signature

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Date

Dedication

To my wife Suchithra, thank you for your love, patience and understanding (and sometimes brutal honesty) that enabled me to complete this research.

Shravan and Sunaina, for accepting, even when you didn't understand.

Dad- I wish you could have been here to witness this, this is for you.

Mum – for your quiet encouragement and support.

Acknowledgements

To my supervisor, Dr Lucienne Abrahams, whose guidance and support was instrumental in ensuring that this research reached completion. I had all but given up until you stepped in.

Dr Andrew Barendse – thank you for the hard lessons and guidance during the initial research phase.

Prof. Ewan Sutherland and Dr Kiru Pillay for your guidance and support.

My colleagues at ICASA for your time, experience and enthusiasm in supporting this research.

The industry specialists that were interviewed, for the passion and depth of our engagements.

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1.1 Introduction

There exists a regulatory framework called Equipment Authorisation (EA) that has a significant impact on the digital economy[1]. EA frameworks have been adopted by most developed countries by the end of the 20th century and are responsible for controlling the supply of all electronic communications equipment into that country. There are classically defined approaches to EA regulation, following either a social policy approach or an economic one. While there is a multitude of compelling reasons for using either approach, the socio-economic factors uniquely prevalent in developing countries intensifies the importance of ensuring that the approach to EA regulation is appropriate to the needs of that country. The phenomena being investigated is the approach to EA regulation in developing countries. This thesis develops an innovative theoretical approach to EA regulation that best articulates the requirements of a developing country.

1.2 Background to the regulation of EA

The Electronic Communications (EC) landscape is evolving. The term EC as used within the scope of this study would refer broadly to the emission, transmission or reception of information using magnetism, radio or other electromagnetic waves (RSA, 2005:9). As we move into the digital economy, we can observe three distinct generations of telecommunications markets (He, 2010:287). The first generation was characterised by a highly regulated state-owned (and sometimes state-provided) monopoly system, based on analogue technology. This was followed by a more liberalised second generation telecommunications market, characterised by open structure networks with accelerated innovation. This second generation telecommunications market was based on deregulation and the introduction of competition. The third and current generation of telecommunications market relies on high-capacity fibre and wireless systems supporting mass consumer

[1] Digital Economy can be defined as "... the incorporation of data and the Internet into production processes and products, new forms of household and government consumption, fixed-capital formation, cross-border flows, and finance" (IMF, 2018).

converged operations. A changing EC landscape needs to be complemented with an effective regulatory environment to support and attract investment (Coulter, Negishi & Foskett, 2010).

The United Kingdom (UK) realised this as far back as 2008 and set about positioning itself as a global technology leader that promoted both a regulatory approach and a digital economy attractive for technology investment, with the Digital Economy Act of 2010 (Coulter, Negishi & Foskett, 2010: 25). Mahan and Melody (2005:15) argue that regulation should be constantly responsive to changing conditions. This view is supported by Wright and Head (2009:191) who stated that current models of regulatory governance need to adequately capture and explain the characteristics and operations of existing regulatory spaces. Bourreau and Dogan (2001:168) argue that the telecommunications industry is the most dynamic industry that has sector-specific regulators and a high speed of innovation, hence the theoretical approach to regulation underpinning the practical approach needs to move just as quickly to keep up with the pace of innovation.

The essential requirements for sustainable economic growth in a developing country are the provision of efficient, reliable and affordable infrastructure services (Kirkpatrick, Parker & Zang, 2006:144). As a developing country, South Africa needs to ensure that its regulatory approach is conducive to investment and economic growth. A particular critical area is the EC equipment market, as it is a significant contributor to the GDP of South Africa. The EC equipment market was estimated by Kaplan (1992) to be valued at two billion Rand in 1992[2]. Current estimates[3] put the value of the market at more than 20 billion Rand, although the actual value has not been accurately determined. Internationally, the export value of EC equipment was approximately 670 billion dollars in 2013 (WTO, 2014). The rapid growth of the "Internet of Things" (IoT), as shown in Figure One, will further fuel these number, with commentators predicting up to 50 billion devices connected to the internet by 2020[4]. The EA

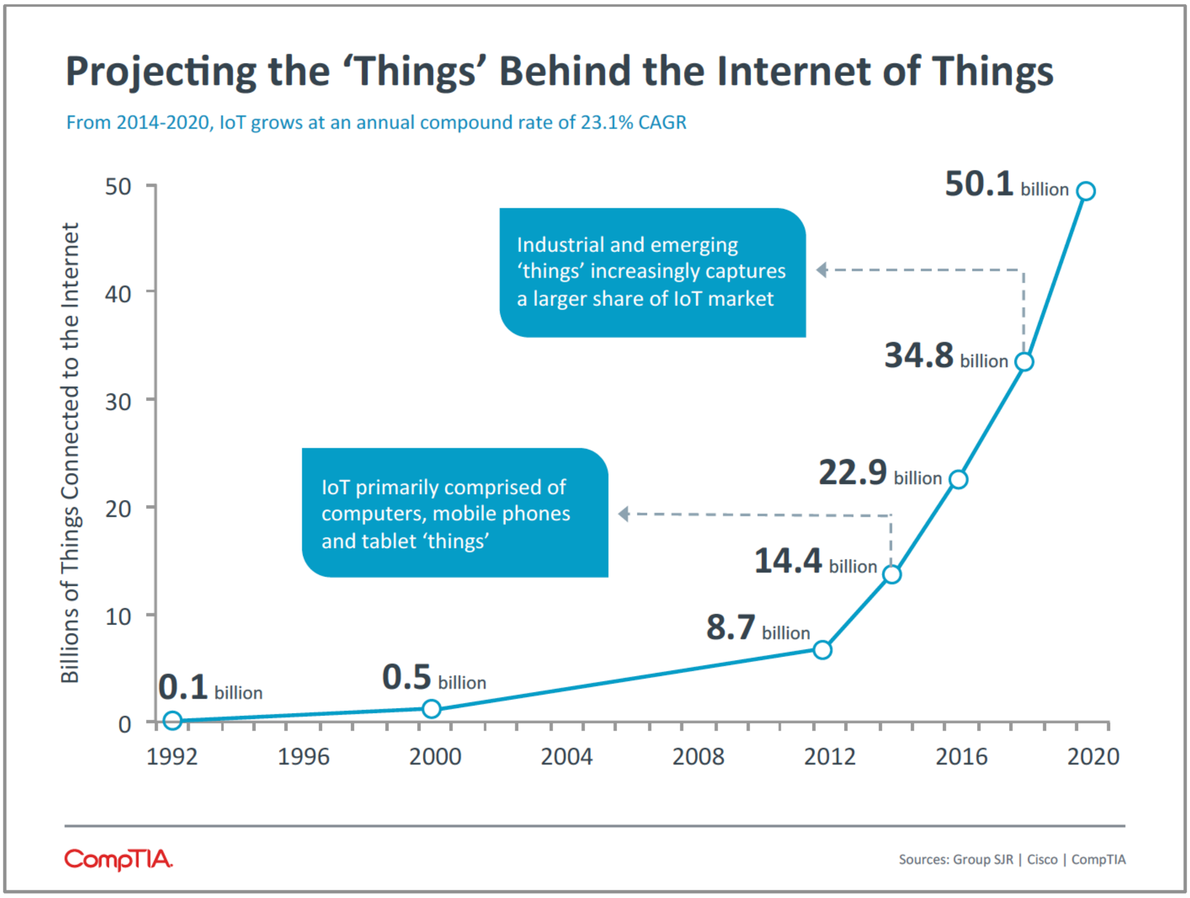
[2] This figure would be much higher when adjusted for inflation.

[3] Figure estimated by the Type Approval unit of ICASA (30 June 2011)

[4] This is CompTIA's estimation (Computing Technology Industry Association). More information can be found at https://www.comptia.org/resources/sizing-up-the-internet-of-things

process would have to be applied to each device to ensure that the cumulative impact of these devices does not degrade network interoperability and quality of service.

Figure 1: The growth of connected devices that would require EA



Source: Computing Technology Industry Association (CompTIA)

The Equipment Authorisation (EA) process is key to the provision of telecommunications infrastructure, as no equipment may be (legally) used in a telecommunications network in South Africa, without first being approved by the regulator (ICASA, 2013). EA is an important process to manufacturers, importers and distributors wishing to market EC equipment to be used on any network in a country. EA (or type approval as it is known in some jurisdictions) details the minimum set of regulatory, technical and safety requirements that a product would need to meet before it can be certified for use in a particular country (ITU, 2012:9).

The “Carterfone” (Ford, Koutsky & Spiwak, 2008) ruling of 1968 by the Federal Communications Commission is of significance, in that it was a case of regulatory intervention that allowed a competitor’s equipment on the incumbent’s telephone network. The need for EA can be attributed to this single landmark ruling, as it liberalised the EC equipment market. Before the Carterfone ruling, only the incumbent network operator would supply equipment to be used on its network, negating the need for an equipment authorisation regime. The European Commission Directive 88/301/EEC essentially adopted this principle, by liberalising the supply of EC equipment in the European Union (EU, 1998). The FCC ruling has been applied to other areas of the equipment supply market in the United States, the latest being the “wireless Carterfone” rules which essentially mandates networks service providers to allow the user to use a wireless handset of their choice (Ford *et al.*, 2008:649). Wireless service providers were locking handsets to their network, setting data bandwidth limitations and limiting features of wireless equipment. Critics of these practices asserted that these restrictions have led to the restriction of competition in the market and called for regulatory intervention that banned these practices. The regulation intervention that followed became known as the “Wireless Carterfone” rules.

The importance of equipment authorisation regulations is highlighted by the Carterfone and Wireless Carterfone cases. The principle that applied to the Carterfone case in 1968 was argued almost 40 years later, in 2007, with the Wireless Carterfone debate. This principle of open access has been implemented in other communications markets such as set-top boxes and cable television in the United States. EA rules and processes are thus still relevant and critical to the communications industry, given that the fundamental policy decisions taken more than 40 years ago are still being applied within the same industry, with a different technology. This strengthens the argument for an appropriate theoretical approach to regulation, rather than drafting new regulation applicable to changing technology. The regulations applicable to EA should be technology agnostic to ensure that technological change does not render them obsolete. What makes the Carterfone case more interesting is that research by Ford *et al.* (2008) show that Carterfone-esque regulations may harm competition in that market and increase barriers to entry, rather than decrease them. They further show that Carterfone regulations may inadvertently increase prices of handsets without any reduction in prices for wireless network services. Hence regulations that were meant to promote public interest by reducing prices and increasing choice may affect markets in a converse manner. The economic and social welfare implications brought about by these EA regulations are thus called into question, more so in developing countries, as they are arguably more vulnerable to increasing prices.

Kirkpatrick *et al.* (2006:166) show that Foreign Direct Investment (FDI) in a developing country responds positively to the existence of a credible regulatory framework. If a developing country makes the transition from developing to developed, a credible and innovative regulatory framework could be considered as one of the key elements to that transition. With such compelling arguments in favour of developing a credible regulatory framework, it would seem simple to adopt the successful deregulation approach to EA of countries in the European Union (Salisbury, 2000) and the United States of America (FCC, 2012). It should be noted that these are first world countries and such changes to the regulatory framework are underpinned by the applicable theoretical approaches to regulation relevant to first world countries. The regulatory framework underpinning developing countries, on the other hand, are faced with far more challenges than developed countries as they have to deal with issues like “poor infrastructure, weak economic conditions and inefficient institutions inherited from pre-reform eras” (Gasmi & Virto, 2010:275) as well as poor administrative resources (Ogus & Zang, 2005:131). With regulatory reform being critical to developing countries, the OECD (1991) has recognised that, although the trade in EC equipment is one of the key issues that have arisen from the changing EC landscape, regulatory intervention is still required to preserve economic and social concepts.

In South Africa, the Independent Communications Authority of South Africa (ICASA) has the overall responsibility for setting standards, certifying that EC equipment meets these standards and enforcing policy and regulation in South Africa (RSA, 2005). It is important to note that ICASA does not conduct conformance testing (i.e. the physical testing of EC equipment to a specified standard), but only specifies the standard to which the equipment should prove conformance. ICASA will accept a test report from any accredited test laboratories that show conformance to the specified standard, but the testing process is costly and places an economic burden on the equipment supplier. The EA regulatory approach should ensure that the economic benefit of regulation should outweigh its economic burden

(Ogus, 1994:13; Bartle, 2009:692). Even if the regulation intends to protect consumers and create a safer product, it may still be problematic. A regulation that purports to promote a safe and reliable product may lead to unnatural barriers to entry, thereby favouring certain suppliers to the detriment of others (Ogus 1999:225). In this case, the objective of regulating in the public interest is overshadowed by the unintended consequences of excluding potential suppliers, which may then exacerbate the burden on consumers as prices of EC equipment could increase due to a lack of competition. There also exists a debate regarding the efficiency of regulation in the public interest. There is an assumption that public interest regulation is effective and can be administered at the least possible cost, which adds to the complexity of regulating in the public interest (Posner, 1974:336). This assumption is critical to developing countries as they are faced with impediments such as “poor infrastructures, weak economic conditions, and inefficient institutions inherited from the pre-reforms era” (Gasmi & Virto, 2010: 275). These institutions would not have the resources to ensure that regulation is economically efficient. The term “public interest” is thus a key factor in determining an appropriate regulatory approach to EA.

Interviews with the communications regulator in South Africa have shown that ICASA has concerns about successfully moving to a fully liberalised regulatory framework, due to the lack of monitoring and enforcement resources available in South Africa.[5] Ogus and Zang (2005) support that concern when they state that “…in many developing countries, an adequate infrastructure for the monitoring and enforcement of ex-post systems of regulatory control does not exist” (Ogus & Zang, 2005:142). It is also evident that a regulatory approach that supports deregulation has had a substantial positive economic impact on the EC equipment supply industry (OECD, 2012:11). It is thus challenging for a regulator in a developing country to balance the social agenda that regulation requires, against the economic windfall that deregulation encourages. Numerous previous studies have addressed the link between regulatory reform and economic growth in developing countries (Gasmi & Virto, 2010; Fink, Mattoo & Rathindran, 2002; Gutierrez, 2003; Ros, 1999; Li & Xu, 2004), but

[5] Interview with Type Approval unit of ICASA, 30 June 2011

none to my knowledge have focused on the economic and social implications of EA reform, particularly in a developing country environment

There is hence more research required in determining a theoretical approach to regulating EA in a developing country. This research thus focuses on studying the limitations of the current theoretical approaches to EA regulation, using the South African environment in developing an innovative theoretical regulatory approach to EA, bearing in mind the complexities inherent to a developing country.

1.3 Four observable trends in EA regulation in South Africa

The rapid introduction of new technologies and the high growth in telecom markets have proven challenging to ICASA's mandate and the present working of the EA regime. Four trends have been observed with regards to EA in South Africa. These trends seem to suggest that the current regulatory approach is not suited to a developing country like South Africa. These trends are[6]:

i) Total EA Applications received has increased ten-fold over the period 2000-2014.

ii) The total processing time per EA application has grown three-fold over the same period.

iii) The amount of harmful interference by approved equipment reported during the period 2004-2011 has increased significantly.

iv) An increase in the number of non-type approved equipment confiscated during the period 2006-2009 has increased substantially (ICASA, 2015).

It should be noted that these trends cannot be attributed solely to the EA environment, as several other contributing factors may affect these trends.

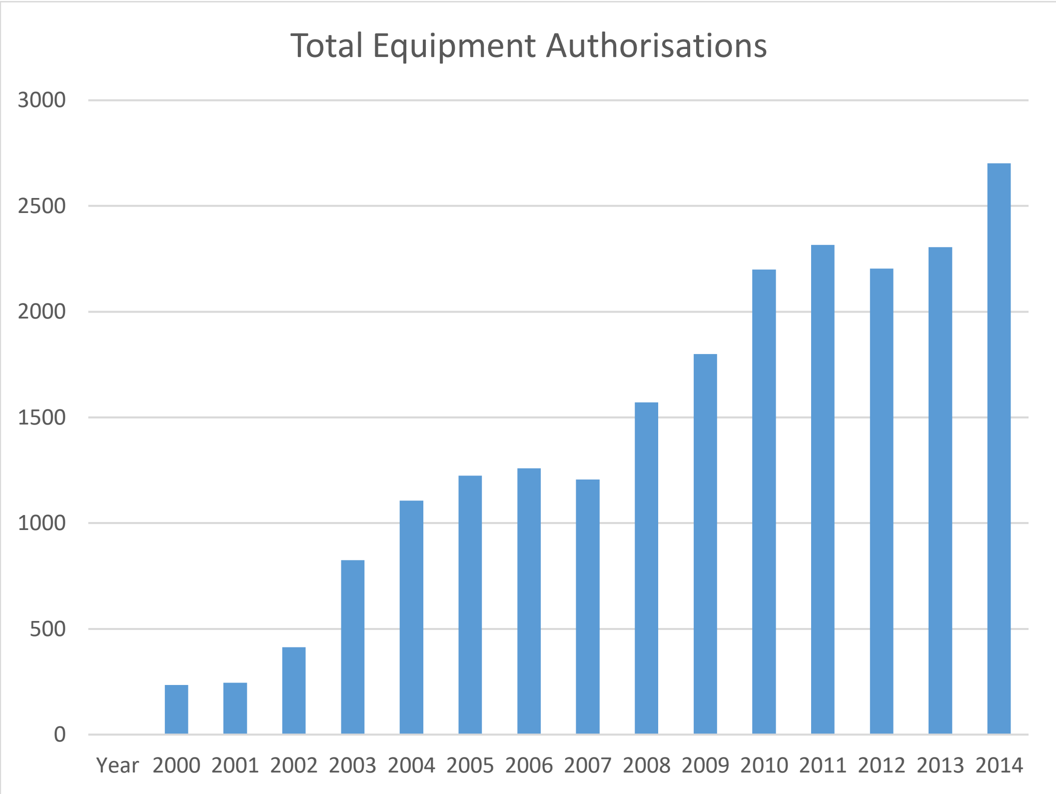
These patterns (discussed in greater detail below) show that while the changing telecommunications markets warranted a change in the approach to EA regulation, the current approach has not changed and real problems can be observed.

[6] All figures were provided by ICASA's Type Approval department in 2011 and ICASA's regional offices in 2012.

1.3.1 An increase in the total applications for equipment approval

This trend deals with the total number of EA applications that have been submitted to the regulator over the last ten years. Figure Two shows that the total number of equipment authorisation applications have increased more than tenfold[7] over the period 2000 -2014.

Figure 2: Total equipment authorisations in South Africa for the period 2000-2014



Source: ICASA Type Approval unit, personal communication, July 13, 2015.

The increase in the number of authorisations indicates that the number of products sold in South Africa is proliferating. The fact that the EA market is growing does not shed light on the on the limitations of the current theoretical approaches to EA regulation in itself, but it is

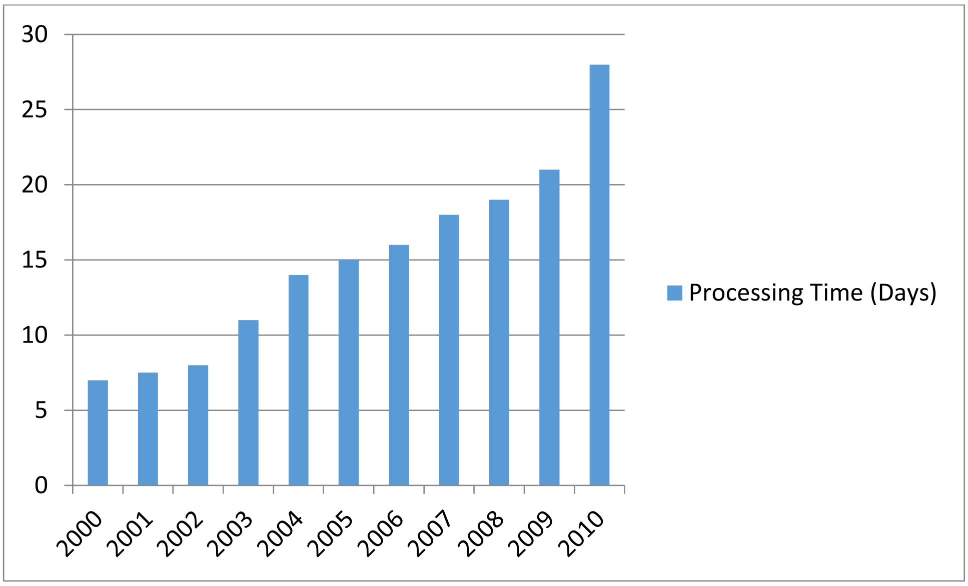
[7] Interview with the Type Approval unit of ICASA (30 June 2011).

telling when coupled with an analysis of the processing time. The processing time of EA equipment will be discussed in the next section.

1.3.2 An increase in the processing time for equipment approval

Technology and market developments have challenged the overall efficiency of the EA regime. Figure 3 shows that the average processing time per application for the period 2000-2010 has increased three-fold. The primary cause cited by the Type Approval Department of ICASA for this increase in processing time, was not the increase in the number of applications but problems with the regulatory approach that guides the type approval process.[8]

Figure 3: Processing Time of Equipment authorisation applications



Source: ICASA Type Approval unit, personal communication, June 30, 2011.

The increase in processing time per application, coupled with the increase in the total number of applications, gives a more precise indication of the challenges that the current approach to regulation has on EA. The command and control approach to regulation (used currently for EA regulation) creates a substantial administrative burden for the regulator, which has to scrutinise and evaluate each application (Ogus & Zhang, 2005:132). The increased processing time for these applications also imposes a cost on the applicant as well as the consumer, since both parties ultimately will not have access to the product until the application process is

[8] Interview with the Type Approval unit of ICASA, 30 June 2011

complete (Ogus & Zhang, 2005:132). This is also an excellent example of the challenges faced by the current approach to EA regulation, as the regulation should not add undue cost to the approval process.

Another issue that relates to the inefficiency of the current EA approach is a duplication of the application process. The current EA process requires that equipment authorised by the Original Equipment Manufacturer (OEM), needs to be authorised once again by any other suppliers that are independent of the OEM supplier, effectively duplicating the approval process.[9] An example would be a cellular telephone supplier who is not the OEM supplier, importing a branded cellular telephone via a parallel distribution channel, having to obtain EA approval for an identical product that has already been approved by the OEM supplier.

This is in contravention of the overarching legislation that governs EA approval in South Africa, which states that ICASA may prescribe:

> ..the types of equipment, electronic communications facilities and radio apparatus, the use of which does not require approval where such equipment, electronic communications facilities and radio apparatus have been approved for use by the European Telecommunications Standards Associations or other competent standards body where the equipment complies with the type approval standards prescribed by the Authority (RSA, 2005:31).

For reasons unknown, this clause is yet to be implemented by the regulator and proof of compliance with performance standards is still required, even if the equipment has been approved for use in Europe by a competent standards-setting body (RSA, 2005:31). To prove compliance to the regulator, test reports from accredited test laboratories must be submitted to the regulator. If the entity applying for type approval of a particular product is not the original manufacturer of the product, getting hold of these test reports can be very difficult.[10]

While to the casual observer, informational costs (such as providing test reports) may not be a problem in a first world country, it is a critical issue in a developing country, where test

[9] Interview with Type Approval unit of ICASA, 30 June 2011

[10] The requirements for type approval was provided during and interview with the Type Approval unit of ICASA, 30 June 2011

reports that are required for EA approval are expensive to procure or difficult to source from the OEM (as the OEM would generally would not provide support to 3rd part suppliers). This is particularly the case when a small non-OEM supplier is importing equipment into the country.[11] This approach to EA regulation is pertinent to developing countries with limited administrative resources, as the costs of securing information are passed onto the supplier and not the administration (Ogus & Zang, 2005:131).

The requirement of test reports for EA also points to the larger issue of trade and innovation. South Africa is not considered a major manufacturer of EC equipment, with only 3.1% of the world total of EC equipment manufacturers based in Africa (WTO, 2014). This means that South Africa is mostly a net importer of EC equipment and highlights the importance of developing an EA framework that promotes trade and innovation.

The documentation required for type approval can be described as the informational costs associated with type approval. There are also application and licensing fees for each EA application made (RSA, 2013). These can be described as the transactional costs of type approval. The transactional and informational costs required to comply with EA regulations could be considered as factors that contribute to market failure. Hertog (1999:225) further distinguishes other costs of regulation:

i) The costs of formulating and implementing regulation;
ii) The costs of maintaining regulation;
iii) The costs of compliance with the rules for industry;
iv) The deadweight costs resulting from distortive changes in connection with i-iii.

[11] The difficulty in procuring test reports was cited as a key problem in the EA process during an interview with the Type Approval unit of ICASA, 30 June 2011

The costs of formulating and implementing EA regulations in South Africa does not seem to be well quantified. The 2013 EA regulations in South Africa had cost the regulator hundreds of thousands of rand in consultancy fees alone.[12] This figure did not take into account the public hearings, labour and time costs incurred by ICASA to develop this regulation. The same applies to the expense of maintaining these regulations. These informational costs have contributed to the increase in the overall processing time of EA applications.

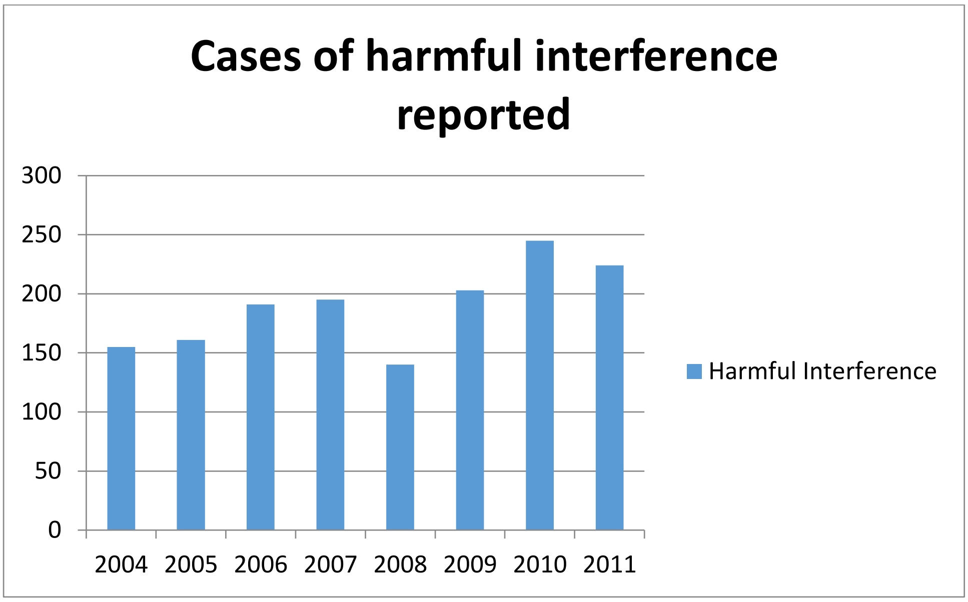
1.3.3 An increase in the number of harmful interference incidents reported

The ITU (2012) defines harmful interference as “Interference which endangers the functioning of a radio navigation service or other safety services or seriously degrades, obstructs or repeatedly interrupts a radiocommunication service operating in accordance with the Radio Regulations” (ITU, 2012:10). One of the critical functions of EA regulations would be to minimise harmful interference (Magallanes, 2011:1). As previously discussed, EA checks if the equipment being subjected to EA has fulfilled the essential requirements in terms of safety, electromagnetic compatibility and performance according to specific standards. It is this check that ensures that the equipment would not cause harmful interference. Harmful spectrum interference can be considered as one of the key measures to assess the effectiveness of the EC EA regime. If an EA regime worked effectively, the incidences of harmful interference should be minimal. The current EA regime has not been very effective in this regard as well. Figure Four shows that the total number of harmful interference cases caused by EC equipment has increased significantly since 2004.[13] There are several factors that could affect these figures, although the key point to note is that type approved equipment should not cause harmful interference.

[12] The figures were obtained from an internal ICASA document that listed the cost of the “Review of Type Approval Framework” project that was completed by ICASA in 2013.

[13] Figures provided by the regional offices of ICASA through email interactions (19 September 2012).

Figure 4: Harmful Interference Reported 2004-2011



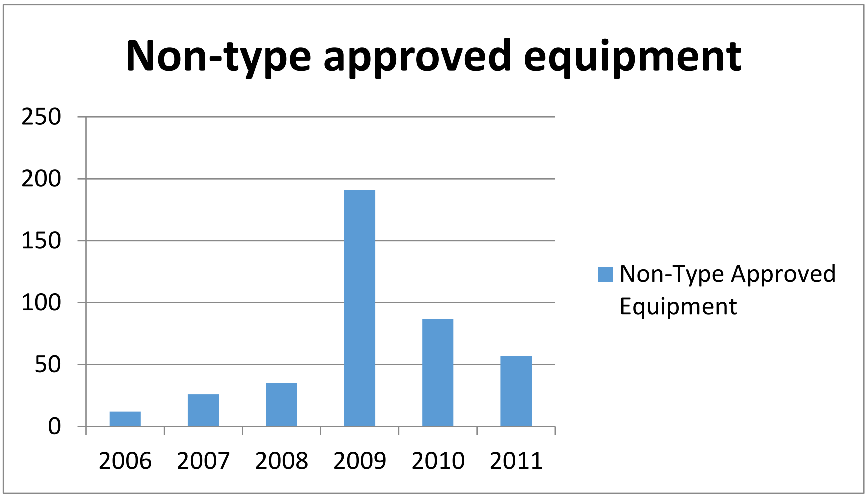
Source: ICASA regional offices, consolidation of email information, September 19, 2012.

There exists a debate around the issue of harmful interference and the appropriate regulatory approach, with regulators like the Federal Communications Commission (FCC) of the United States (US) looking at ways to redefine harmful interference to ensure that the development of new radio systems is not inhibited (Marcus, 2008:6). These approaches are intended to maximise the economic value achievable with EC equipment, by developing systems that enable spectrum to be used more effectively, rather than relying on traditional methods for achieving this (Marcus, 2008:6). Veenstra and Leonhard (2008) discuss software defined radios as one such system. They do admit however that “the ability of a Software Defined Radio to dynamically modify its operating parameters surely can help managing interference; however the potential for causing interference to other authorized radio services cannot be overlooked” (Veenstra & Leonhard, 2008:19). These systems represent a challenge for the regulator as “the declaration of conformity as some species of *ex-ante* regulation must stay valid despite any eventual *ex-post* changing of the operating parameters of the equipment” (Veenstra & Leonhard, 2008:22). This argument links the effect of the evolution of telecommunications technology unique to the EA environment, with a need to review the approach to EA regulation.

1.3.4 An increase in the number of non-type approved equipment confiscated by ICASA

EC EA regulations are meant to be an enabling environment for the approval of EC equipment, but a growing number of EC suppliers have chosen to sell their equipment illegally by not having their equipment type approved by ICASA.

Figure 5: Non-type approved equipment confiscated by ICASA 2004-2010



Source: ICASA regional offices, consolidation of email information, September 19, 2012.

This trend is highlighted in Figure Five. The purpose of EC EA would be to ensure that all EC equipment is compliant with the relevant standards set out by the regulator (ITU, 2012:9). Figure Five shows the total number of non-type approved equipment confiscated by ICASA per year, which increases rapidly from 2006 until 2009. ICASA inspectors were then asked to scale back on type approval inspections, until the legal status of inspections could be determined.[14]This explains the decrease in non-type approved equipment from 2009 until 2011. This trend highlights a challenge faced by the current public interest approach to EA regulation. An increase in the number of pieces of equipment confiscated by a regulator may be considered indicative of the inappropriateness of the current EA approach. An effective and efficient EA regime that does not create barriers to entry for suppliers would have led to decreasing numbers of non-type approved equipment. Non-type approved equipment

[14] Interview with ICASA regional Office 29/10/12

essentially ignores the public interest goals of the regulator by bypassing the regulatory process completely.

1.3.5 Implications of these trends for the EA regime in South Africa

The trends and challenges have shown an increasing level of inefficiency and ineffectiveness of the present EC EA process in general. Rapid introduction of new technologies and high growth in telecom markets have proven challenging to ICASA's mandate and the current working of the EA regime. Technology and market developments have challenged the overall effectiveness of the EA system. There is a trend of an increased processing time of EA applications, with duplicate approvals being conducted.

The trends support a claim of increasing ineffectiveness and inefficiency of the current EA approach in fulfilling a mandate of regulating in the public interest. The present regulatory approach is also challenging to regulating with economic efficiency. With the evidence presented in the preceding sections, it could be argued that a need exists to develop an innovative approach to EA regulation that is cognisant of the complexities of developing countries such as South Africa. The present EA regulatory approach would thus require an assessment of its ability to address dynamic changes in the technology and markets of a developing country.

1.4 EA in theory and practice

There are three distinct regulatory approaches to EA, namely certification, verification and declaration of conformity (Magallanes, 2011:1). In essence, these EA regulatory approaches are either a command and control regulatory approach or a self-regulation approach. These approaches are detailed by the administrative procedures that dictate the EA process.

1.4.1 Three EA approaches

a) Certification or licensing

Manufacturers, importers or distributors of EC equipment wishing to sell such equipment in South Africa, are required by law to ensure that the equipment they provide, conform to regulated technical standards. Proof of conformance can be obtained by testing the equipment at ICASA accredited test laboratories, and submitting these test reports to ICASA for assessment.[15] This process is called certification and is considered to be the most time-consuming of all EA approaches, as such a process may have previously been undertaken in other countries (Magallanes, 2011:1). This process is at times referred to as "licensing" in other regulatory environments.

Licensing tests whether the applicant meets substantive conditions, as well as the suitability of the application to numerous conditions (ICASA, 2013). This is the current EA approach in South Africa. The licensing process is in itself divided into different scales of regulatory scrutiny (Ogus & Zhang, 2005:125). They describe a "rubber stamp" (Ogus & Zhang, 2005:125) licensing process, where the application is not scrutinised but merely approved based on the information provided. The second licensing process is a more rigorous and involves a thorough investigation of the application (Ogus & Zhang, 2005:125). The licensing EA process is on the extreme end of the licensing process spectrum as described above, with the regulator requiring large amounts of informational evidence, before the EA licensing process can be successfully concluded. As discussed earlier, ICASA requires test reports for EA approval. A test report in three categories is necessary for each product being considered for type approval (ICASA, 2013). These categories are safety, electromagnetic compatibility and equipment performance. This results in a significant amount of information being required before a product can be considered for EA. This process is consistent with public interest principles.

Ogus and Zhang (2005) argue for the abolition of licensing in developing countries and propose a less interventionist regulatory strategy that can better serve the public interest. Minogue and Cariño (2006:134) conclude that an EA licensing regime imposes more compliance costs on entrepreneurs, more administrative costs on officials and more welfare losses on consumers than an independent regime. Given the high level of regulatory oversight

[15] The type approval process was explained at an interview conducted with the type approval unit of ICASA on 30 June 2011.

and the structured approach of using tests reports in this approach, licensing is regarded as a command and control strategy.

b) Verification

Magallanes (2011:1) describes verification as the simplest of the three approaches for obtaining equipment authorisation. It allows an equipment manufacturer to verify its equipment, with no additional external tests required by the regulator. Ogus and Zhang (2006) define the verification process as “registration”. Registration “involves the actor to furnish the regulatory authority with accurate information prior to being able to engage in a business activity” (Minogue & Cariño, 2006: 115). Regulatory officials would keep the information on file, without having to test whether the applicant meets substantive conditions set out by the regulatory authority. Verification differs from certification or licensing, in that the burden of proof lies with the supplier, with the regulator accepting on good faith, that the equipment conforms to the required technical specifications.

Verification is considered as a form of self-regulation in which the manufacturer merely verifies compliance with regulations. Research conducted in this field shows that this type of economic deregulation has had a positive benefit for both consumers and producers alike (Magallanes, 2011:1; Hertog, 1999).

c) Declaration of conformity

Declarations of Conformity (DoC) allow the manufacturer to outsource equipment testing to an accredited test laboratory, and the results of these tests are used to declare conformity to a standard (Magallanes, 2011:1). DoC is also be considered a form of self-regulation, with a component of regulatory oversight (Magallanes, 2011:1). This approach would allow the OEM to apply for EA in a block of countries based on the initial test report, resulting in considerable savings.

There are several reasons that could be put forward to support a de-regulated or self-regulated market. Hertog (1999:246) describes some of them by listing three reasons for deregulation:

i) a changed balance of power of pressure groups
ii) structure-induced equilibrium can be disturbed by the actions of political entrepreneurs, such as the chairpersons of regulatory commissions
iii) Politicians can seek political support for deregulation by providing voters with information about the inefficiencies of regulation of all be accounted for by. Alternatively, politicians could try to use the complexities of regulatory issues by claiming that economic deregulation would greatly advance economic and social welfare.

The claim that deregulation would automatically advance economic and social welfare in the EA sphere would have to be investigated thoroughly. This claim would be discussed in greater detail in the next section, but it is important to bear in mind that most of the research conducted in this field have been either focusing on deregulation in general in developing countries or would have looked at EA regulation in developed countries. The case of EA deregulation in a developing country is a combination that would require further study.

1.5 The rationale for regulation

EC equipment cannot be broadly categorised into levels of product preference, i.e. consumers cannot choose to pay less for an inferior unsafe product (or a product with fewer features), as all EC equipment approval have a health and safety related component as previously discussed. This means that the public interest justification for regulation holds a higher level of influence than for other products that are subject to regulation. The critical factor for regulating public safety would be to determine the optimal level of intervention. Ogus (1994:191) states that "the more technologically complex the determinants of quality, the fewer policymakers are likely to rely on information regulation". This essentially implies that EC equipment, given its technical nature, would be highly regulated as the regulator would not rely on information provided by licensees. The regulator would require this information upfront before approval is provided. The challenge to developing countries would be the capabilities and skills to process this information, since authorities in developing countries have relatively scarce skills and experience in these areas (Makhaya & Roberts, 2003:42). EC equipment, however, also have very short product cycles, requiring quicker EA times. An "inferior" product would still have to be as safe as any other product, although it may be significantly cheaper. The approach to regulation would thus have to ensure both safety and economic value.

Ogus (1994:180) goes further in determining the relationship between the risk creator and the potential victims. These risks are specific to health and safety or social concerns, which apply to EA. A good example would be the heterogeneous relationship between an industrial factory contaminating the atmosphere and the victims of pollution. In this example, the victims are diverse and numerous and are, therefore "…unlikely to constitute a coherent pressure group" (Ogus, 1994:180) to address their concerns. The other end of the spectrum would be a homogeneous relationship between an employer and employee, where unions could address safety issues in a collective manner (Ogus, 1994:180). The EA scenario of health and safety would be at the midpoint of either extreme. Consumers having product quality and safety issues, "…have a market relationship with producers but are less well-placed than employees to negotiate standards, both because of the difficulty and the cost of effective organisation" (Ogus, 1994:180). This is a compelling argument in favour of regulatory intervention on behalf of the consumer on public interest grounds, where the regulator would be responsible for ensuring product safety by setting enacting appropriate regulatory measures.

1.6 The discourse of EA regimes and the gap in the knowledge

A study similar to the one envisioned here was conducted by Knapp and Wall (1997:28) reviewing the FCC EC EA. Their proposals were to:

a) Simplify current (at that time) equipment authorisation procedures;

b) Liberalise the equipment authorisation requirements for certain equipment and;

c) Provide for electronic filing of equipment authorisation applications

In their study, Knapp and Wall (1997) did not provide alternatives to full liberalisation and suggested the change in the EA regime to be in line with the trend worldwide. Their study also did not investigate the local conditions of the EC market. While Knapp and Wall (1997) may have taken for granted that issues like access to test facilities may be inconsequential in a developed first world country, such issues are of significant importance in a country like

South Africa as the cost to set up such facilities may be prohibitive. It was also not the focus of their study to balance the social requirements with the economic impact of the new regulation.

Research by Veenstra and Leonhard (2008) has shown that new technologies would have a significant impact on regulatory regimes, and changing technologies must be catered for when considering a liberalised EA regime. The FCC EA regulations are promulgated in terms of Section 302 of the US Communications Act of 1934 (Wall, 1995). This section allows the FCC to make regulations that are consistent in terms of the public interest. The FCC approach seems to focus on the social aspects of regulation from the description of Knapp and Wall (1996, 1997).

A study by Pelkmans (1987) looked at a new approach to technical harmonisation and standardisation. This study looks at the framework that would eventually become known as the R&TTE directive. Pelkmans' study mainly focuses on removing the barriers to trade within the EU and also does not suggest alternatives to complete liberalisation.

Howard and Mazaheri (2009) conducted a study on the telecommunications reform in developing countries. In their study, they conclude that the ideal regulator in a developing country would focus on the public interest, but would not be above entering into agreements with private sector entities to pursue an economic agenda. Their findings are specific to mobile phone adoption and internet access.

A significant amount of empirical literature has been analysed by various commentators that shows a positive correlation between regulatory reform in developing countries and economic gains (Gasmi & Virto, 2010; Fink *et al.,* 2002; Gutierrez, 2003; Ros, 1999; Li & Xu, 2004). These studies look primarily at introducing competition in the mobile and fixed telephony areas and do not focus on the EA regime.

The US and EU are first world economies with mature telecommunications markets. Their move from a regulated EC EA environment to a liberalised one was generally successful. Although various commentators have extolled the value of moving from a regulated environment to a liberalised one (Horwitz, 1989; Ogus, 1992; Jordana & Levi-Faur, 2003; He, 2010 Gasmi & Virto, 2010; Fink et. al, 2002; Gutierrez, 2003; Ros, 1999; Li & Xu, 2004), very little has been theorised on the approaches to EA regulation in developing countries. From the literature surveyed, it seems that there is either research conducted about regulatory reform in developing countries as well as EA regulatory reform in developed countries, but not EA regulatory reform in developing countries.

This research starts from the existing theoretical approaches to EA regulation in developing an innovative theoretical approach to EA regulation, while considering the complexities pertinent to South Africa as a developing country. Simply proposing regulatory reform based solely on an economic calculation (such as for example using the Kaldor-Hicks efficiency theorem[16]) may not be a viable solution, as an optimum solution should contribute to the understanding of the theoretical approaches to applying EA regulation.

1.7 The generalisability of developing countries

It is a difficult task to generalise developing countries as a unique entity. Even though developing countries may share several similarities, they each may be in different stages of development. The stages of economic growth by Rostow (1960) is regarded as one of the vital economic models that describe growth in developing countries. The model theorises that growth can be defined in five major stages of varying length:

i. Traditional Society. This initial stage is the most basic stage, characterised by a primitive society with access to little or no technology. This society is primarily dependent on agriculture on its main economic activity.
ii. Preparatory Stage. This stage lists the socio-economic and political changes that are a pre-requisite before the next stage can be achieved.
iii. The Takeoff stage: This is an economic period that could span decades in which the rate of investment and per capita output increases. This stage is also characterised by technological innovation.
iv. Drive to maturity. This is a period of self-sustaining growth of the economy. There is large scale investment, particularly in infrastructure, as well as industrial growth.

[16] The Kaldor-Hicks efficiency theorem is a measure of economic efficiency used extensively in the calculation of welfare economics. See https://www.economicshelp.org/blog/glossary/kaldor-hicks/ for a detailed definition.

v. Age of Mass consumption. This final stage signifies a shift in focus from primary activities such as food production to the production of consumer goods.

Rostow's (1960) model, although frequently criticised, provides a clear indication that development occurs on a sliding scale rather than an immediate transition. Developing countries could fall into several of the categories listed above and could find themselves in a transitory period between these defined stages. Porter, Sachs and McArthur (2002) have defined a scale that is more easily generalisable and pertinent to this study. In their aim of developing a country competitiveness index, they have defined three specific economic development stages and two transitionary stages:

i. Factor-driven stage. This stage is characterised by the trade in natural resources and the use of unskilled labour.
ii. Efficiency-driven stage: The focus of this stage is on more efficient means of production leading to higher output and better quality products. There is less self-employment in this stage as the formal job market would grow as production increases.
iii. Innovation-driven stage: New products and services are created using technology and innovation. There is an increase in entrepreneurial activity driven by innovation and growth.
iv. The transitionary stages are between stage one and stage two as well as between stage two and stage three.

This characterisation is essential to the study as it provides a platform to distinguish between developing countries. The World Economic Forum (WEF, 2015) produces an annual report, shown in Figure Six, that categorises countries into the developmental stages defined by Porter *et al.* (2002). This report uses two criteria to determine the stage of development of a country. The first criteria used is the measure of Gross Domestic Product (GDP) per capita at market exchange rates. The second measure acts as a correction to this categorisation by factoring in the extraction of resources and trade of mineral goods. The table of countries are categorised as follows:

Figure 6: Countries/economies at each stage of development

Stage 1: Factor-driven (37 economies)	Transition from stage 1 to stage 2 (16 economies)	Stage 2: Efficiency-driven (30 economies)	Transition from stage 2 to stage 3 (24 economies)	Stage 3: Innovation-driven (37 economies)
Bangladesh	Algeria	Albania	Argentina	Australia
Burkina Faso	Angola	Armenia	Bahrain	Austria
Burundi	Azerbaijan	Bulgaria	Barbados	Belgium
Cambodia	Bhutan	Cape Verde	Brazil	Canada
Cameroon	Bolivia	China	Chile	Cyprus
Chad	Botswana	Colombia	Costa Rica	Czech Republic
Côte d'Ivoire	Gabon	Dominican Republic	Croatia	Denmark
Ethiopia	Honduras	Egypt	Hungary	Estonia
Gambia, The	Iran, Islamic Rep.	El Salvador	Kazakhstan	Finland
Ghana	Kuwait	Georgia	Latvia	France
Guinea	Libya	Guatemala	Lebanon	Germany
Haiti	Moldova	Guyana	Lithuania	Greece
India	Mongolia	Indonesia	Malaysia	Hong Kong SAR
Kenya	Philippines	Jamaica	Mauritius	Iceland
Kyrgyz Republic	Saudi Arabia	Jordan	Mexico	Ireland
Lao PDR	Venezuela	Macedonia, FYR	Oman	Israel
Lesotho		Montenegro	Panama	Italy
Madagascar		Morocco	Poland	Japan
Malawi		Namibia	Russian Federation	Korea, Rep.
Mali		Paraguay	Seychelles	Luxembourg
Mauritania		Peru	Suriname	Malta
Mozambique		Romania	Turkey	Netherlands
Myanmar		Serbia	United Arab Emirates	New Zealand
Nepal		South Africa	Uruguay	Norway
Nicaragua		Sri Lanka		Portugal
Nigeria		Swaziland		Puerto Rico
Pakistan		Thailand		Qatar
Rwanda		Timor-Leste		Singapore
Senegal		Tunisia		Slovak Republic
Sierra Leone		Ukraine		Slovenia
Tajikistan				Spain
Tanzania				Sweden
Uganda				Switzerland
Vietnam				Taiwan, China
Yemen				Trinidad and Tobago
Zambia				United Kingdom
Zimbabwe				United States

Source: World Economic Forum (2015:13)

South Africa is categorised in Figure Six as a stage two economy. A stage two economy classification is an efficiency-driven economy. This categorisation assists in identifying developing countries in similar stages of development as South Africa. There are 30 other developing countries in the world which are categorised in the same stage as South Africa. As this study is grounded by data obtained in South Africa, the generalisability and applicability of the theory developed in this study would be best suited to countries within the same developmental stage as South Africa. Even with this caveat, it is imperative to underline that grounded theory develops theory limited to the chosen data boundaries. The research in itself has a particular focus on understanding the unique characteristics of South Africa as a developing country. The theoretical sampling and theoretical completeness of this study are thus limited to a specified population of the EA environment of South Africa.

With that said, this study could form a suitable theoretical basis for future studies in other developing countries, as its theoretical underpinning is not based on the classical regulatory approaches to EA. While this study is delimited within the substantive area of the EA environment of South Africa, a formal theory can be developed by generating abstract concepts and specifying relationships in multiple substantive areas (Charmaz, 2006:8). By focusing on multiple developing countries and removing any delimitations, a formal theory of the approach to EA regulation in developing countries can be developed. This is however beyond the scope of this research, as the focus would solely be on developing a substantive theory of EA in a developing country, with a delimitation to South Africa.

1.8 Why grounded theory?

Grounded theory has evolved appreciably since initially being first introduced by Barney Glaser and Anselm Strauss in 1967. Their approach to qualitative research focused on a systematic process to formulate theory directly from data gathered during social research (Glaser & Strauss, 1967). The area of their study focused on dying in hospitals and culminated with a detailed analysis and a theoretical explanation of the social organisation and the temporal order of dying. (Charmaz, 2006). Glaser and Strauss (1967) shared the methodical strategies adopted for their study for other social science researchers to follow, when studying other topics. This approach to qualitative research has been the subject of various methodological debates since, but the core of grounded theory as a mechanism to generate theory remains valuable.

The premise of developing a theory directly from data grounded through a logical process of deduction, aligns well with the focus of this research, as the assertion of this research is that the current theoretical approach to EA regulation seems to be problematic. Ongoing methodological debates in grounded theory have been crucial in fine tuning and clarifying the seminal work of Glaser and Strauss (1967). The original authors themselves diverged in their approach to grounded theory, and a short account of these differences is included as part of the methodology discussion.

Charmaz (2006) is one of the new generation of grounded theory writers who have built upon the original works of Glaser and Strauss (1967). This research is based on the grounded theory methodology proposed by Charmaz (2006), as her approach is best suited in the context of the study undertaken. Charmaz (2006) provides an interpretation of grounded theory and suggests methodological advice, guidelines and perspectives by re-examining the classical statements of grounded theory of the past century, through the theoretical lens of the present century. Charmaz (2006) adopts the theoretical and methodological assumptions of several decades of scholarly debate and provides principles and practices (not inflexible rules) that suit a qualitative research environment.

This modernisation of the classical grounded theory ideology rings true to the intent of this research - looking at an old problem through a new lens. Grounded theory in itself helps the researcher "…foster seeing your data in fresh ways and exploring your ideas about the data through early analytic writing" (Charmaz, 2006:2). The concept of developing an innovative theoretical approach to EA regulation in a developing country can thus be considered as a realistic goal, should an appropriate methodology be adopted that can deliver on that stated objective. The concept of what is considered innovative is also discussed as part of the literature review, but it is important to note that grounded theory as a qualitative methodology is by itself a powerful tool that can be used to develop a substantive theory in this particular area of research.

The focus of this study is not to simply generate a new and improved mechanism to conduct EA in a developing country. The focus of this study is instead to develop a theoretical explanation of the EA environment in a developing country. The statement by Strauss and Corbin (1998) that grounded theory facilitates the move from a description of what is happening to an understanding of the process, by which it is happening, is significant as is articulates the approach adopted in this research. While the research has gathered data in first addressing the more practical issue of applying an appropriate approach to regulation, the end product is a theoretical explanation of this practical approach. I.e. it moves from a description of an innovative approach to EA regulation, to a higher level of theoretical abstraction in understanding this process. This theoretical explanation is grounded in the data gathered as a result of a qualitative exploration of the EA environment in a developing country.

Grounded theory is not a theory in the classical academic sense, it is rather a method of qualitative data research that uses systematic and flexible guidelines for collecting and analysing data, to generate theories grounded in the data itself (Charmaz, 2006:2). Using these guides and method of analysis, the data gathered as part of the research was coded, compared and analysed to generate a level of theoretical abstraction. The final product of theoretical abstraction is the purpose of the investigation, rather than the practical considerations that formed part of the journey in obtaining the required data. The contribution to new knowledge is therefore a theoretical focus, rather than a practical exercise. This academic focus is framed by the particular subset of data gathered for this study and is thus applicable only to the particular environment being researched. A common mistake made by grounded theory researchers is to increase the population size of the research. The error is in assuming that the focus of grounded theory is generalisability. The logic of grounded theory applies to the specific population of the data and collecting unnecessary information only leads to gathering conceptually thin data (Charmaz, 2006:101). Grounded theory is thus an ideal tool that is utilised to achieve the required results of the study.

1.9 A summary of the research problem

While deregulation has been successful in many first world countries, the impact of liberalisation in a developing country is a pertinent subject of research, especially with a focus on a regulatory approach for EA. The unique challenges of a developing country introduce a level of complexity not catered for by the current theoretical approaches to EA regulation. There may be a need to preserve the social agenda of regulation, while still being cognisant of the economic windfall associated with deregulation. Real world problems have been observed that stem from the use of the current EA regulatory approach. This study therefore analyses the South African EA environment using a lens of current theoretical approaches, while ultimately focusing on developing an innovative substantive theory grounded in the environment of a developing country. A study of the South African environment is useful to other developing countries, hence the findings and conclusions of this study would be of value to developing countries with similar levels of development as South Africa.

1.10 Problem statement

The current theoretical approach to EA regulation has proven problematic to resource-poor countries. Initial research in the South African EA environment has revealed several real-world trends that show that the current approach to EA regulation has limitations when faced with a changing EC landscape. The popular approach of EA deregulation that has proven successful in many first world countries, may not apply to developing countries given their unique challenges. These challenges, such as a lack of administrative resources, poor infrastructure and a lack of ex-post regulatory monitoring add to the complexity of designing an appropriate theoretical approach to EA regulation. The primary focus of the current public interest EA regulatory approach in South Africa ensures that social obligations are met, to the detriment of economic imperatives. A predominantly economic-focused approach, however (such as a deregulated model of EA regulation), does little to ensure that social obligations are met. Research has shown that even deregulated markets require some form of regulatory intervention to preserve economic and social concepts (OECD, 2012). This summary of the research problem (and the subsequent literature review based on initial assumptions of the research problem) represents a naïve picture of the research at hand. There exists a need to develop an innovative theoretical approach to EA regulation that is grounded in empirical data generated in a developing country, to develop a rich picture of the environment.

1.11 Purpose of the research

The purpose of the research is to develop an innovative theoretical approach to EA regulation that can be applied to a developing country such as South Africa, to address the limitations presented by the current theoretical framework. This is achieved by first understanding the challenges brought about as a result of the current theoretical framework. The unique challenges of a developing country, in relation to a theoretical approach to EA regulation, is investigated next. The research finally proposes an innovative theoretical approach to EA regulation, grounded in South Africa.

1.12 Research questions

1.12.1 Central question

In which ways can innovative theoretical approaches to regulation be applied to the EA regime of a developing country, in order to address possible limitations presented by the current theoretical approaches?

The central question is further broken down into three sub-questions, where each sub-question will address specific aspects of the central question.

1.12.2 Sub-questions

- In which ways does the current theoretical approach to regulation pose challenges to the EA regulatory approach?
- Why are the characteristics of a developing country unique and how can these characteristics be considered when developing an innovative theoretical approach to regulating EA?
- How can an innovative theoretical approach be created that addresses the challenges of the current theoretical approach to regulating EA?

1.12.3 Questions context

The current EA framework was examined by the first sub-question, identifying the challenges faced by the current theoretical approach, thereby identifying the problem areas of the current approach. The sub-question also investigates how effective and efficient the current approach is, regarding regulating in the public and economic interest.

This second sub-question gives context and determines the unique characteristics of South Africa as a developing country. It investigates the characteristics unique to developing countries that specifically impact EA regulation.

The final sub-question investigates the manner in which an innovative EA approach can be created in a developing country, by suggesting an alternative to the classical theoretical regulatory approaches. It assesses the responses of the previous questions and develops an innovative approach that addresses the limitations presented by the current theoretical framework.

1.13 The significance of research into theoretical approaches to EA regulation

A study into developing innovative theoretical approaches to equipment authorisation in South Africa is important for several reasons. Initial evidence has shown a real-world problem that emanates from the theoretical approach to regulation. Previous studies have approached this problem, either in an environment of a developed country, or studied the effects of deregulation in developing countries in general. A study of an innovative theoretical approach to EA regulation in a developing country would thus be of value to developing countries looking to implement a regulatory approach that is grounded in the requirements unique to developing countries.

2. Literature review of regulatory theory relevant to EA approaches

2.1 Introduction

Before engaging in the literature reviewed for this study, it should be noted that there are several debates concerning the use of literature before commencing a grounded theory study. Glaser (2009) is firmly opposed to exploring the literature prior to the commencement of the data gathering. Glaser is of the opinion that conducting a literature search before the data collection, will distract the researcher and prevent them from seeing the emergent categories from the data. He promotes conducting the literature review after the researcher has conducted an independent analysis of the data (thereby preventing distractions and letting the theory emerge from the data). Charmaz (2006) supports this view and notes that there exists a danger of focusing on the research through the lens of earlier theory - resulting in "received theory" (Charmaz, 2006:165). Charmaz suggests somewhat of a compromise, by stating that the literature can be reviewed in the build-up to the research, but ignored until the researcher can develop categories and analytical relationships based on the research data. The approach by Charmaz (2006) has been adopted in the study and relevant literature in the EA field was surveyed, and the study is located in the discussions that follow.

This literature review argues, that although developed countries have migrated to an economic focus on EA regulation, there exists a gap in the approach to EA regulation for developing countries. This liberalised approach to regulation, in general, has been studied in great detail in developing countries, but without a specific focus to EA. The critical theoretical assumption of public interest theory regarding regulatory efficiency is also discussed and is shown to be problematic to developing countries.

The literature review thus focuses predominantly on the economic theory of regulation, public interest theory and regulatory strategy theory, with specific emphasis on equipment authorisation. The core aspect of regulatory strategy is driven by the theoretical approach to regulation and can be further distilled into the key concepts of command and control, self-regulation, design standards and output standards. These key concepts are also elaborated upon, concluding with a discussion on the Diffusion of Innovation theory as well as New Trade theory. The aforementioned theoretical framework, along with the key concepts, is the foundation on which this research is undertaken.

The starting point of the literature review is to investigate the best known EA approaches.

2.2 Some examples of well-known EA approaches

The European Radio and Terminal Telecommunications Equipment (R&TTE) Directive 1999/5/EC is possibly the best known EA framework worldwide. This framework ushered in a new era for the type-approval of equipment in Europe. This formed part of the *light touch* approach to regulation that was envisioned by the European Community (Dillingham, 1999; Salisbury, 2000). These changes to regulatory regimes occurred around the world from the mid-nineties onwards, in response to globalisation and the integration of international markets (Ogus, 1999:223). In terms of this directive, equipment suppliers had only to declare conformance to a harmonised standard listed in the Official Journal of the European Communities (Salisbury, 2000). It provided a simpler procedure for manufacturers to enter the market, thus stimulating the market and improving the economy (Salisbury, 2000). More emphasis was placed on market surveillance and manufacturers' liability, rather than an *ex-ante* approach where emphasis is placed on product conformity, before the product goes to market.

The European Council had realised early on that the EC market at that time was fragmented and did not realise the potential of a single European market (Müller, 1989). The old process was also not appropriate in the technical areas, as the pace of technology change dictated that the technical standards should change just as rapidly (Salisbury, 2000). Unfortunately, technical specifications embodied in legal documents meant that change was a slow and arduous process.

The post-1999 approach was to leave the essential requirements in law and separate the technical requirements into technical standards documents. The standards bodies thus produce harmonised standards in response to requests from the European Commission, which are published in the Official Journal of the European Communities. A manufacturer can thus create a product according to a harmonised standard, and the European Community member states are obliged to presume that the equipment meets the requirements of the law. The manufacturer has expressly to identify which directives relate to his product and declare conformance to that directive. This regulatory approach ensured that national regulatory systems did not become barriers to trade (Ogus, 1999:223; Müller, 1989).

Another popular equipment authorisation approach is managed by the Federal Communications Commission (FCC), using Telecommunications Certification Bodies (TCB) to conduct equipment approval on its behalf. The FCC (2012) also conducts approvals itself, allowing declarations of conformity for EC equipment. The FCC has a handbook which sets out regulation applicable to equipment authorisation. Again, this approach was a less interventionist one that sought to better facilitate the EA process by making the EA process simpler (Knapp, 1997).

Most first world countries have adopted a variant of either the FCC or EU approach to regulating EC equipment. What is telling though, is the lack of current academic literature on EA regulatory approaches. It would seem that first world countries have adopted a *de jure* deregulatory approach to EA regulation, stemming from the wave of telecommunications deregulation witnessed in Europe during the 1990s (Ogus, 1999:223).

2.3 Origins of economic and social regulation

As the EA approach is a regulatory one, it is important first to understand the historical roots of regulation in general. The first question intuitively to ask would be: “What is Regulation?” Baldwin and Cave (1999:2) define regulation as being a binding set of rules designed to influence industrial or social behaviour. Ogus (1999:223) defines regulation as a type of public law that the state uses to encourage a particular type of conduct, which would not have occurred without such regulation. Regulation has been part of modern society for a considerable period. Ogus (1992:6) shows that regulatory intervention dates back to the Tudor and Stuart periods and MacDonagh (1958:52) states that there was a burgeoning of regulation in the nineteenth century, with the emergence of specialist regulatory institutions, especially in the supply of railway, water gas and electricity services. These regulatory measures were put in place to ensure control over the quality of service, prices and safety.

The first independent regulatory body was established in the United States in 1887 (Baldwin & Cave, 1999:3). This body was the Interstate Commerce Commission formed to deal with issues such as discriminatory pricing and workplace health and safety. It was also in the United States that the "…notion of regulation had acquired a narrower meaning in response to the rise in the number of independent regulatory institutions and the consequent crystallisation of regulatory practices into a theory of governance" (Jordana & Levi-Faur, 2003:4). Jordana and Levi-Faur (2003:4) later describe regulation as a form of governance, and they note how deregulation has become a major political agenda for politicians as regulatory frameworks have advanced. Jordana and Levi-Faur (2003) define deregulation as "the reduction of economic, political and social restrictions on the behaviour of social actors" (Jordana & Levi-Faur, 2003:5).

This change in the evolution of regulation is of importance to the study, as deregulation is a key theme that is explored. Jordana and Levi-Faur (2003:6) define deregulation as "the reduction of economic, political and social restrictions on the behaviour of social actors". Regulatory frameworks have evolved as markets have evolved, but deregulation as a popular political agenda for regulatory evolution may not be the solution for a developing country.

2.4 Regulation and EA

For equipment authorisation, the rationale for regulating is the protection of the equipment user and the protection of the telecommunications network. Breyer (1982:34) points out that health and safety regulation would be justified as a rationale for regulating. This view is echoed by Jordana and Levi-Faur (2003:32) and Ogus (1999:223) who point out that social regulation would deal with health and safety, environmental and consumer protection. EA regulation is enacted to ensure EC equipment compliance to standards set by the regulator regarding public health and safety, performance and interoperability of the equipment as well as to minimise harmful interference (ITU, 2012:9). The elements of EA regulations that are health and safety related are thus aligned with the social aspects of regulatory theory. The public interest objectives would be to ensure that social, rather than economic considerations are at the forefront of the regulator's agenda. This approach to regulation is known as the public interest theory of regulation and will be discussed in greater detail in the next section.

Environmental regulation, regulation of product safety and labour conditions are generally opposed by private entities as these regulations would increase the cost of compliance, which would, in turn, have a negative effect on profitability (Hertog, 1999:235). It is this balance between public and private agendas that is critical for a regulator when regulating EA.

There is also an economic aspect of EA regulations, which states that the type and form of regulation would have to be the most efficient. The net costs of the regulation should not overshadow the net benefits of the regulation (Ogus, 1994:13; Bartle, 2009:692). This is described in further detail as the economic theory of regulation. The EA market contributes billions of dollars annually to the world economy (Carr *et al.,* 1998:5) and any regulatory approach would have to be mindful of the economic impact that it carries.

2.5 Public interest theory

A regulator’s task of balancing the demands of both public and private actors can be daunting. In accommodating these diverse interests, the regulator sometimes has to be guided by an overarching principle in terms of the public interest. Beecher (2008) says that a good regulator “embraces the public interest” (Beecher, 2008:578). Telecommunications, and by extension, the supply of telecommunications equipment, is considered to be imbued with public interest (Horwitz, 1989:11). Hertog (1999:3) provides the following definition of public interest theory specific to regulation: ” …regulation is the instrument for overcoming the disadvantages of imperfect competition, unbalanced market operation, missing markets and undesirable market results”. Mclean (2004:42) has a similar definition when he notes that “regulation is the solution to certain sorts of market failure, especially market failure due to natural monopoly”. Public interest theory can therefore be summarised as an approach where regulation is developed in pursuit of public interest related objectives in reaction to market failure.

In this theory, the regulator of the sector has to act as an "expert" (Baldwin & Cave, 1999:19). This theory applies to the EA regulatory framework as equipment authorisation is conducted in the public interest and the regulator acts as an impartial expert in evaluating the equipment authorisation requests. Public interest theory holds the perspective that regulation is established in response to the conflict between private corporations and the general public (Horwitz, 1989:23). It can be argued that private companies are vested in creating wealth for their shareholders, and equipment manufacturers would be no different. EA regulations should ideally have to be designed in the public interest, to mitigate against the aforesaid conflict. The biggest consideration for public interest theory, however, would be to strive for the lowest cost form of regulation (Bartle, 2009:692). This involves creating regulation that does not unnecessarily burden the consumer, while still holding true to the public interest. This is a vital link to the economic theory of regulation, which will be discussed in greater detail shortly.

Kohlmeier (1974) paints a bleak picture of the US regulatory agencies in the 1970s (specifically the Interstate Commerce Commission (ICC) and the Federal Trade Commission (FTC)). He states that these regulatory agencies are not serving the interests of the public, but are rather focuses on the economic issues with a bias towards private corporations (Kohlmeier, 1974:100). This situation changed with the regulatory agencies later in the 1990s, especially with the FCC. Levi (2008) provides an account of how the FCC moved back towards public interest perspectives in their regulations during the 1990's and 2000's, after a long period of focus on economic regulation, attributed to a change in political direction.

An important rationale for regulation is market failure (Jordana & Levi-Faur, 2003). Public interest theory states that regulation is the solution to market failure (Jordana & Levi-Faur, 2003:45). One definition of market failure would be that the market failed to optimise social welfare and acted to pursue its self-interest (He, 2010:287). Externalities (such as pollution in the case of environmental regulation) would have to be regulated to ensure consumer protection (He, 2010:287). The assumption that public interest theory can quantify the value of such externalities and hence correct the failure optimally through regulation is problematic. The transactional and informational costs of regulation in terms of EA would be challenging for the regulator to determine, given that most of this information lies in the hands of industry. Externalities such as interference caused by unauthorised equipment would be nearly impossible to quantify. The statement that regulation could optimally address market failure in the EA environment is thus dubious, given that the costs of such a failure would be difficult to determine.

Developing countries, in particular, would be more susceptible to these externalities, as they generally have weak economies and poor infrastructure (Gasmi & Virto, 2010: 275), hence it would be prudent to assume that the need for regulation in developing countries to optimise social welfare may be much higher than developed countries.

The biggest criticism of public interest theory is its propensity for regulatory capture. Opponents contend that self-interested business groups "capture" regulators for their private interests (Bartle, 2009:691). The economic actors use the significant resources at their disposal to ensure that the regulatory authority is coerced into pursuing actions that maximise their utility value (Bartle, 2009:691). He (2010) has a similar view and points out that regulatory capture by special interest groups leads to weak and ineffectual monitoring.

Public interest theory states that regulation is the solution to market failure, especially monopolies (Jordana and Levi-Faur, 2003:45). Dominant operators may be inclined to monopolise the supply of equipment on their networks. This could lead to a failure of the equipment supply market, as the EA process would act as a barrier to entry into the equipment supply market.

Another definition of market failure would be that the market failed to optimise social welfare, and individuals acted to pursue their self-interest (He, 2010:287). In this case, negative externalities (like consumer health and safety) would have to be regulated to ensure consumer protection. This is the case with EA regulation being introduced to ensure that consumer health and safety issues are not ignored in favour of corporate self-interest.

Posner (1974) criticises public interest theory based on a critical assumption of the theory that regulation is effective and could be implemented without significant cost. This is the second link to the normative description of the economic theory of regulation, which will be discussed later in this study. Tanguay, Lanoie and Moreau (2004) have a similar definition of public interest which highlights Hertog's (1999) assumption that regulation is effective. Tanguay *et al*. (2004:1) stated that "At the optimum pollution level, government intervention will ensure that the marginal cost of eliminating pollution is equal to the marginal damage caused by the pollution". This statement again assumes that regulation would be "optimum", and in the real world, this is hardly the case. This is certainly an area that the research addresses, by understanding the efficiency limitations of the current theoretical approaches to EA regulation given the complexities of a developing country.

An insidious application of public interest theory is cited by Hertog (1999). Hertog claims that larger organisations would support the sometimes onerous and costly administrative burden that accompanies regulatory intervention. This may seem counter-intuitive, given that companies would seek to maximise profits and minimise input costs. The rationale behind this approach is that larger corporations are better able to absorb the costs associated with regulation, which may prove unbearable to smaller companies, causing them to be driven out of the market (Hertog, 1999:241). This, in turn, reduces competition in the market and impedes the market, which is contrary to the objectives of regulatory intervention.

As previously discussed, the "Carterfone" ruling was a landmark ruling that paved the way for the deregulation of EC equipment (Ford *et al.*, 2008). This ruling by the FCC allowed telephonic devices unaffiliated with Bell Networks (the fixed-line monopoly incumbent at that time in the US) to be used, should they follow the standards prescribed by the FCC necessary to facilitate interoperability between the device and the network. It was well understood at the time that the Bell Telephone network was vertically integrated into the Western electric company, who was the sole supplier of equipment to the Bell network. This meant that the Bell Telephone Network would have had an incentive to sabotage the deployment of a rival's equipment onto their network as they had significant market power, was vertically integrated and this practice was regulated (Ford *et al.*, 2008:649). The FCC "Carterfone" regulations banned the bundling of the telephone device with the telephone service, opening up the market to third-party suppliers. This free market promoted competition, lowered prices and fostered innovation in this area. It is important to note that the regulation was developed in a monopolistic market, with a vertically integrated incumbent with market power. The question that Ford *et al.* (2008) raise is whether such EA regulations are still applicable in the modern wireless market. They point out that the current wireless market in the US is a highly competitive one, with several operators completing aggressively for market share. The conditions of vertical integration do not exist in this market hence the potential for sabotage does not exist. The third component that existed during the "Carterfone" watershed ruling was price regulation, does not exist in the current US wireless market. Ford *et al*. (2008) argue that the three paramount conditions that gave rise to the "Carterfone" regulations are no longer present in the current wireless market, yet the same type of "Carterfone like" regulations still apply to the wireless market (Ford *et al.*, 2008:659). They make a convincing argument that shows that the commoditising of the wireless networks due to open access type EA regulations would be harmful to the consumer. This view is supported by Faulhaber and Farber (2010), who show that a high level of innovation due to competition exists in the wireless market, thus regulation in this market would not be appropriate. Open access networks allow customers to move freely between networks, without any long-term commitment, which may lead to operators becoming insolvent and thus decreasing competition in the market. Mobile operators who are not allowed to cross-subsidise the cost of a mobile handset with the cost of the service, would increase the handset price which would in turn negatively affect the consumer (Ford *et al.*, 2008:673). This is an interesting take on the public interest perspective of EA regulation, as the defining EA regulation that was once lauded for liberating the EC equipment industry, may yet lead to its downfall. The supposed benefits of regulation (such as consumer choice and prices driven down by competition in the US example) may be outweighed by increased costs due to a lack of cross-subsidisation or increased costs due to fewer operators who can survive in the current economic climate. Ford *et al.* (2008) suggest a move back to allowing network specific equipment with the sole intention of circumventing the pitfalls of applying the "Carterfone" like regulatory intervention to competitive markets that are not vertically integrated.

Wu (2007) has a view that challenges some of the assertions made by Ford *et al.* (2008). He states that the wireless network carriers in the US can be considered to be an oligopoly, as although these markets are considered open markets, the multi-billion price tag required to enter this market can be regarded as restrictive enough to prevent entry (Wu, 2007:393). The market power of these carriers is such that they can prevent entry into vertically integrated markets as well. It is worth remembering that the arguments of Ford *et al.* (2008) and Faulhaber and Farber (2010) focus primarily on the premise that the Carterfone regulations were developed for a monopolistic market, at a time when there existed a vertically integrated incumbent with market power. Such types of regulation are no longer required for the open cellular markets without vertical integration in the US. The arguments by Wu (2007) show that while the wireless network market in the US can be defined as an open market using a classical definition of the term, there exist extenuating circumstances that prevent entry to these markets, effectively rendering the market an oligopoly. Wu (2007) provides an instructive historical parallel between the 1960's Carterfone regulatory initiative and the present day wireless environment that exists. He points out that voice telephone networks had reached a point of saturation of technology under the guise of AT&T leadership in the 1960's, and that innovation could only occur through deregulation of the equipment supply market (Wu, 2007:394). In the present day scenario, only progressive policy initiatives would be able to propel the wireless industry to the next stage of innovation.

Public interest is arguably the main theoretical base that has to be considered when investigating an approach to EA regulatory design. EA regulations as previously discussed are imbued with public interest objectives. Public interest as the theoretical underpinning to EA regulation alone, however, falls short when considering the complexities of a developing country. The assumption that public interest based regulation can be implemented optimally in a developing country would have to be tested. The perceived value of regulation developed in terms of public interest and its actual impact would also require investigation. It is also evident that changing markets will affect the implementation of public interest type regulations, and regulations that were previously applicable to the EC equipment market may no longer serve the intention of public good. It is even conceivable that such well-intentioned public interest regulatory measures may even be detrimental to the public interest.

2.6 Economic theory of regulation

Another underlying theme that is prevalent in the literature is the economic theory of regulation. The economic theory of regulation was proposed by Stigler (1971). Stigler (1971:3) proposed a theory of the supply of regulation, where demand for regulation came from those who required regulation, as it would better their circumstances. Essentially, industries will acquire regulation for their purposes as they are the primary benefactors of such regulation. The supply of regulation came from the regulatory authority. Many commentators have built upon this theory, including Hertog (1999), Ogus (1994) and Jordana and Levi-Faur (2004), who have applied it to the telecommunications environment.

Hertog (1999) describes a distinction between the positive and normative theories of economic regulation. He states that the “positive variant is directed to the economic explanation of regulation and deriving the consequences of regulation. The normative variant investigates which type of regulation is the most efficient” (Hertog, 1999:10). In other words, the positive theory explains why regulation is applied, while the normative theory predominantly focuses on improving economic efficiency by reducing costs. Both the normative and the positive aspects of the economic theory of regulation apply to the study. The positive variant in this context would focus on reducing the cost of compliance with EA regulations, while the normative aspect would look at the balance of EA regulations from an economically efficient point of view.

A summary of Ogus’ (1994) analysis of economic theory is that the market that requires intervention must first be identified. The second step would be to select the method of intervention that would correct this failure, at the least cost (Ogus, 1994:13). It is the second step that is most applicable to this research, as the regulatory strategy chosen by the regulator should ensure that the lowest cost is incurred, while still correcting the market failure.

Jordana and Levi-Faur (2003:32) attribute market failure to several factors such as externalities, information deficiencies and lack of competition. Externalities and information deficiencies are referred to as “social regulation” (Jordana & Levi-Faur, 2003:32). These are health and safety as well as consumer issues. The third factor, the lack of competition, is referred to as economic regulation (Jordana & Levi-Faur, 2003:32). These are generally price control regulations imposed in natural monopolies or oligopolistic markets. In essence, market failure as defined by Jordana and Levi-Faur (2003) are as a result of both public interest and economic interest variables.

Competition in a market is an essential feature of economic theory. Ogus (1994) provides an excellent description of the key concepts of economic theory concerning competition. The first key concept is a perfectly competitive market. Economic theory posits that:

> …when an industry is "perfectly competitive" it will generate allocative efficiency, the resources of the society being put to their most valuable use. "Perfect competition" exists when the number of firms selling a homogenous commodity is so large, and each individual firm's share of the market so small, that no individual firm finds itself able to influence appreciably the commodity's price by varying the output it sells (Scherer & Ross, 1990:33).

Ogus (1994:22) explains that in the circumstances described above, the manufacturer would produce goods up to the point where the marginal revenue of production equals the marginal cost of the goods. This means that prices of items generated by the manufacturer cannot be inflated to levels beyond the marginal cost of the goods. The market self-regulates this price, since given the definition of a perfect market with several manufacturers, consumers would have the ability to simply choose the manufacturers who have priced their product at the lowest price. This competitive equilibrium ensures that in the absence of externalities:

> …the marginal valuation of consumers will be equal to the marginal cost to produce the commodity and the marginal social benefit and the marginal social cost of producing the commodity are equal; and allocative efficiency will result (Ogus, 1994:22).

This means that due to perfect competition, manufacturers have essentially been forced to maximise their output relative to their input costs. In a monopoly, the opposite essentially applies as the monopolist has no motivation to be efficient, and will hence maximise profits by increasing prices that are more than the marginal cost of production (Ogus, 1994:22). Competition is thus an excellent mechanism to ensure that both social and economic goals are realised with little or no regulatory oversight (Levy, 1996). The real world scenario, however, is almost always never a perfectively competitive market. Imperfect competition exists in the EC equipment supply market, which may somewhat alleviate the economic concerns brought about by supply and demand. The public interest perspective as a result of competition is, however, unclear given that regulatory oversight is required to ensure consumer safety and network interoperability.

Jordana and Levi-Faur (2003) question whether market failure correction is more costly than the perceived benefits of the regulation. This is significant to EA, as the social regulatory intervention must be implemented at the least cost (Bartle, 2009:692). This view is supported by Ogus and Zhang (2005:132), who states that the licensing process creates a heavy administrative burden to the regulator who scrutinises and evaluates these applications. They claim that the time taken for the regulator to reach a decision imposes a cost on the applicant as well as the consumer, who does not have access to the product until the licensing process is complete. They conclude that the public interest arguments need to identify significant benefits to justify the costs incurred using a licensing system.

The most cynical view of the economic theory of regulation comes from Hertog (1999), who states that "The conclusion is that regulation is not directed at the correction of market failures, but at setting up income transfers in favour of the industries in exchange for political support" (Hertog, 1999:37). Hertog explains that companies can organise themselves more efficiently than private individuals. This enables them to lobby politicians more effectively to ensure that their agenda is prioritised, and in return, provide the politicians with votes and other resources to secure their re-election. This take on the economic theory of regulation is very similar to the regulatory capture scenario that was expressed as a flaw of the public interest theory. As both these theories apply to EA, it lends credence to the notion that the theoretical underpinnings of EA regulation require attention as it may no longer be valid.

Jordana and Levi-Faur (2003:31) state that the economic theory of regulation primarily explained how regulation came into being in the 1960s and 1970s, as well as explaining how it failed. He states that this theory is less adept at explaining the deregulation that occurred in the 1980s and 1990s. It is this period of deregulation that is essential to this study, hence a need to understand the intersection of this theory with that of the theory of public interest, to find the area that properly defines the requirements of a developing country. Paleologos and Polemis (2013), however, clearly define a link between regulation and economic growth. They find that there is a significant relationship between a sound regulatory environment and economic growth. Their study also looks at the impact of privatisation and investment in relation to regulatory intervention, with a definite conclusion that privatisation regulation and policies that are implemented by governments contribute positively to economic growth. This finding is somewhat contradictory to Jordana and Levi-Faur (2003), who attribute the period of deregulation as the key contributor to economic growth. Paleologos and Polemis (2013) suggest that regulatory intervention aimed at privatisation promotes economic growth, hence regulation in itself can thus be attributed as key to the intervention that spurs economic growth. These regulations implement a structural measure that is aimed at the market under scrutiny (e.g. privatisation). The key distinction, however, is that Paleologos and Polemis (2013) state that *effective* implementation of policy and regulatory interventions are responsible for the aforesaid economic growth, the emphasis being on the word "effective". Developing countries, as discussed previously, have unique challenges that may render effective implementation of regulation as an impossible task. The principles of economic regulation, such as removing barriers to entry, promoting competition and preventing discrimination of essential facilities remain the same.

The normative explanation of the economic theory of regulation, which looks the type of regulation that is the most efficient (Ogus, 2004:37), seems to contradict public interest theory, which assumes that government regulation is effective and can be implemented without greater cost (Hertog, 1999:10). As explained earlier, it is important to study the intersection of these theories as they are both applicable to EA. The rationale of EA regulations should be aimed at ensuring the social aspects of EA are met, without increasing costs. Hence EA regulations would have to be (in an ideal scenario) drafted in terms of the economic theory of regulation, while still being faithful to the principles of public interest theory.

2.7 A failure of the current theoretical approaches to EA Regulation?

The telecommunication sector mixes the seemingly disparate paradigms of social and economic interest. In this sector, the social returns are in itself reflected in its contribution to economic development (Makhaya & Roberts, 2003:43). Add to this the requirements of a developing country, and it becomes more complex to combine these theories to ensure that EA regulation (or any similar telecommunications regulation for that matter) could be developed with a balance in mind. Ogus (2004) has previously attempted an analysis of both public interest theory and the economic theory of regulation. He finds that economists postulating the economic theory of regulation have become obsessed with finding an overall theoretical framework which "provide(s) a complete explanation of the existence and incidence of regulation" (Ogus, 2004: 42). He also states that the public interest approach "…which assumes that law is made exclusively to generate aggregate social welfare is too naïve." (Ogus, 2004: 42).

It is clear that these competing theories are of significant value to EA regulation, but do not form a complete theoretical framework by themselves. Although they form the theoretical base to which an investigation into the design of EA regulation begins, they appear contradictory and less applicable to the specific needs of a developing country. The requirements and challenges of developing countries required further investigation, as they form the basis on which an innovative theoretical approach to EA regulation is developed. Both public interest and economic theory of regulation theories contain assumptions about the efficiency of regulation. This notion that regulation is efficient and implemented at the least cost, seems implausible given the previously stated administrative challenges faced by developing countries.

2.8 Regulatory strategy theory

Regulatory strategy can be defined as the mechanism adopted by the regulatory agency to fulfil a particular mandate (Baldwin & Cave, 1999:35). Adler (2010: 15) defines regulatory strategy as "modalities of regulations" which he calls the generic legal structure for responding to market failure. Baldwin and Cave (1999:60) list eight different regulatory strategies that can be used to achieve the relevant objectives effectively. For the research, the literature review primarily discusses the command and control strategy and the self-regulation strategy.

2.8.1 Command and control

As discussed previously, ICASA is responsible for EC equipment authorisation in South Africa, under section 35 the Electronic Communications Act (ECA) (RSA, 2005). This approach to EA can be described as a "command and control" regulatory approach, as it involves the setting of standards within a rule to control the quality of a product (Baldwin & Cave, 1999:35). Many countries around the world have abandoned the command and control regulatory approach in favour of more liberalised approaches to regulation (FCC, 2009; Salisbury, 2000).

Command and control regulation is the "exercise of influence by imposing standards backed up criminal sanctions" (Baldwin & Cave, 1999:35). This means that non-compliance of the equipment authorisation regulations is a criminal offence and is punishable by law. Command and control regulations involve the setting of standards within a rule to control the quality of a product (Baldwin & Cave, 1999:35). This again aptly describes the EA regulations as technical standards are used to prescribe the minimum requirements for EA.

One of the main criticisms of the command and control structure is its "propensity to produce unnecessarily complex and inflexible rules" (Baldwin & Cave, 1999:37). This is especially so for EA regulations where the structure of the regulation makes innovation difficult in a fast moving, technology-driven market. He (2010) cites command and control regulations as being especially sensitive to information deficiencies. A command and control EA regime place high informational demand on EC suppliers (as information such as test reports are required to prove compliance), creating the possibility of informational deficiency for the regulator, which is the receiver of the information. Command and control regulations place high informational demands on the applicant as well, by requiring a test report based on a performance standard being produced for regulatory scrutiny, before the equipment can be authorised. Baldwin and Cave (1999) have argued that this regulatory approach "poses a major difficulty for regulators as well, since the informational demands are severe" (Baldwin & Cave, 1999:38). Command and control regulations are well suited to ensuring public interest principles but at a high economic burden.

The British communications regulator OFTEL (at the time) has argued that detailed prescriptive rules can act as a barrier to entry and has moved to an open state form of regulation (Baldwin & Cave, 1999:37). Jordana and Levi-Faur (2003:39) also dwell upon re-examining the rigid command and control methods of regulation by replacing them with financial incentives and general objectives. This view is supported by Ogus (1994) who states that this approach then puts the onus on the industry to devise their own particular rules to meet the required objectives. Jordana and Levi-Faur (2003) have found that there is a worldwide emergence of a less authoritative, less interventionist and more participatory regulatory modalities (Jordana & Levi-Faur, 2003:220). The EU, for example, has moved towards a more indirect approach to behavioural changes by facilitating "new instruments" of regulation, which couple a high level of discretion with a high degree of obligations imposed by the regulator (Jordana & Levi-Faur, 2003:220). These new instruments still ensure that the public interest is protected, but use less intensive mechanisms to achieve the same result.

The pace of technology also dictates the level of regulatory intervention required. Technological change is, in essence, the driving force that determines the regulatory modality discourse (Wiener, 2004). Horwitz (1989) argues that technology "exacerbates the user demands to bypass the basic regulated system" (Horwitz, 1989:221). He (2010:288) goes further to state that in a technologically driven fast paced environment, command and control regulations should not be used. It is clear that an innovative regulatory strategy that is responsive to the environment is required.

Bruneau (2005) shows that command and control regimes used by regulators lead to net losses under trade liberalisation when using design standards and concludes that command and control regimes are considered an inefficient form of regulation.

The command and control regulatory strategy, although widely criticised by many commentators (Breyer, 1982:12; Baldwin & Cave, 1999:37; He, 2010:287), is still the EA regulatory strategy adopted in South Africa. The literature surveyed paints a very one-sided and dim view of the command and control regulatory strategy, but of importance is the absence of criticism of the strategy in ensuring that social obligations are met. This strategy seems to be very effective in ensuring that health and safety requirements are adhered to, so there would be merit in conducting further research into the applicability of this type of regulatory strategy to enforce these social obligations in terms of EA.

2.8.2 Self-regulation: Verification

Baldwin and Cave (1999:39) define self-regulation as an organisation developing its own set of rules that are monitored and enforced by itself. Self-regulation can be applied when it is subject to governmental structuring and oversight (Baldwin & Cave, 1999:39). Ogus and Zhang (2005:131) believe that registration (which will be referred to as verification in the study) could also be considered a form of self-regulation. They argue that there are public interest grounds for introducing registration as it would lead to lower administrative costs (Ogus & Zhang, 2005:131). This is an interesting dynamic, as lower costs are cited as a public interest objective, not an economic one. It is a difficult path, as the implementation of a particular strategy may serve certain public interest objectives (such as lowering costs), but may also result in defeating other public interest objectives (such as ensuring a safe product).

In a study of more than one thousand Spanish companies, Camisón (2010) concludes that "the adoption of more advanced environmental innovations by firms submitted to auto-regulation allowed both a superior improvement and a higher level of environmental performance" (Camisón, 2010: 346). Kolstad (1986) also conducted a similar study on the efficiency of command and control regulations and show that "economic incentive regulations" were several times more efficient than command and control regulations. Self-regulation would certainly lower administrative costs, but the gap in the literature that was surveyed begs the question of whether self-regulation would ensure that all public interest goals are still achieved by this strategy of regulation.

2.8.3 Self-regulation: Declaration of conformity regimes

The conformity assessment procedure internationally is moving towards self-declaration. The Radio Equipment and Telecommunications Terminal Equipment Directive (which was amended in 2014) as previously discussed is a European Commission directive that allows for self-declaration and mutual recognition of telecommunication terminal equipment (Müller, 1989). This directive allows equipment manufacturers to conduct testing to the prescribed standards of the R&TTE directive independently, and then declare that they met the standards without having to submit proof of compliance to the regulator. The directive allowed European Commission countries to benefit from a single equipment market, which was previously fragmented. This would allow European Commission countries to compete directly with the larger US and far eastern European Commission equipment markets. Another positive attribute was that the directive also promoted trade and innovation with the European Commission countries. This form of regulation is incentive based and is considered to be an efficient type of regulatory approach (Bruneau, 2004:538).

The main issue with this strategy based on the literature surveyed thus far is that this strategy seems to still rely on design standards to prove conformity. Another gap in the literature that exists is the creation of a regulatory EC equipment authorisation approach that uses a declaration of conformity regime based on output standards. A more detailed explanation of design vs output standards is discussed next.

2.9 Regulatory strategy and standards

Baldwin and Cave (1999) identified two core areas that should be investigated when regulators incorporate standards into rules. These areas are the types of standards and the level of performance.

2.9.1 Type of standards

Baldwin and Cave (1999) identified two types of standards that can be used by regulators by defining the timing of these standards. The first type was a standard that looked at prevention stage, which focused on “the act that gives rise to a harmful result” (Baldwin

& Cave, 1999:118). These standards are known as “Design Standards” or “Preventative Standards” (Bruneau, 2004: 536; Ogus, 1999:225). This is the type of standard that applies to the specification or design of equipment during equipment authorisation. The second type of standard termed “output standards” and are applied to the “harmful result of an activity” (Baldwin & Cave, 1999:118; Ogus, 1999:225) and looks at implementing sanctions accordingly.

Besanko (1987) cites a good example of standards in the context of air quality regulation. An output standard would place a limit on a factory’s emission of sulphur dioxide (SO_2) per million parts of air, while a design standard would specify the minimum efficiency of a stack gas scrubber designed to reduce SO_2 emissions (Besanko, 1987:34). Applying this to the EA environment, an illustrative example would be a design standard that would specify the maximum power output of a radio transmitter, while an output standard would specify the electromagnetic compatibility limit of the equipment.

The key difference to these types of standards is the cost and difficulty to enforce. The standards that are applied at a preventative stage are relatively inexpensive to enforce with readily calculated compliance costs (Baldwin & Cave, 1999:119; Ogus, 1999:225). Standards thus represent the degree of state intervention, with the key variable being the administrative costs of formulating the standard and monitoring compliance to the said standard (Ogus, 1999:166). This type of standards is currently implemented for equipment authorisation and provides advantages only to the regulator as the cost is borne by the party seeking equipment authorisation. Baldwin and Cave (1999:118) argue that such standards are highly intrusive and may also inhibit innovation and development of new more efficient designs of equipment. Ogus (1999:166) concurs with this view and finds that firms should be given a choice in the mechanism they adopt to meet regulatory requirements, as this encourages innovation in loss abatement techniques. This link between regulation and innovation is an important aspect of this study, as it highlights the relationship between the regulatory path embarked upon and the impact of this path on innovation. The regulatory path is determined by the type of standards that are adopted (Burtz & Hummel, 1984). Theories of innovation will be discussed in greater detail further in this study, but it is important to note that allowing a level of discretion to the regulated firm has a direct bearing on the innovation exhibited by that firm.

Batabyal (2000) developed a theoretic approach to environmental regulation in a manner that decreased inefficiencies and losses caused by regulation. He stated that regulation has to be optimally done in a dynamic and stochastic setting (Batabyal, 2000:115). Holt (2005:190) concurs with this view, suggesting that regulators should balance their regulatory objectives to ensure that prices are not driven up. This ties in with the key themes of economic efficiency versus public interest perspectives discussed in detail earlier.

Output standards in terms of equipment authorisation are applied through electromagnetic compatibility emission limits and "demand a given level of delivery at the action stage" (Baldwin & Cave, 1999:119). These standards focus on the degree of risk that a process creates rather than the actual harm done (Baldwin & Cave, 1999:119). This type of standard is less technologically restrictive and gives firms an incentive to design processes with superior performance levels (Baldwin & Cave, 1999:120). Output standards provide advantages for the equipment manufacturer but are more challenging and costly to the regulator. Holt (2005:195) suggests quality of service standards as output standards with the information on quality provided by the operator, which reduces the burden of proof to the regulator.

2.9.2 Level of performance

Standards setting in the EC equipment context is the process of defining limits in a manner that protects the user and the network that it connects to (ITU, 2012:10). It relates to the type of standards that should be used and the level of performance that should be demanded. These concepts are central to equipment authorisation, as equipment authorisation is a process where standards are used to gauge a certain level of safety, EMC and performance of equipment.

The level of performance is thus another key concept of this research, as it would help determine the type of framework required for equipment authorisation. The level of performance is defined as the level at which regulators need to fix standards to control risk, while still making the equipment economically feasible (Baldwin & Cave, 1999:120). Baldwin and Cave (1999) further explain this concept as one that "seeks to set optimal levels of performance on efficiency grounds by a process in which the costs of harm avoidance are balanced against the benefits" (Baldwin & Cave, 1999:120).

From the literature surveyed in this section, it is apparent that the level of performance determines through regulation, the level of performance required by EC equipment. Setting a very high level of performance may increase the cost of compliance and hence the cost of the equipment. Ogus (1994) aptly describes the economic consideration of regulation that highlights a need for balance, when he states that using the conventional tools of microeconomics, any government intervention should choose a method of intervention that will correct the failure at the least cost. The studies quoted in this section show that much research has been conducted in defining the strategies of regulation, albeit predominantly in the environmental sector. The research builds on that work in the field of communications regulation with the premise that regulation, in general, should be implemented at a level of performance that contributes the least to increasing costs.

It is also valuable to note that compliance costs can vary appreciably over a period that an activity takes place. Ogus (1994) lists the example of the rules that apply to a factory during an active manufacturing phase should not be the same as a time when the factory is inactive. In this example, the standards that are set should be cognisant of the different degrees of generality that applies to rule formulation (Ogus, 1994:169). These rules can be considered to be a sliding scale, with highly precise quantitative rules on one end and general rules on the other. Flexible rules would be able to cater for a variety of circumstances, but are challenging and costly to maintain as it requires interpretation and administration by both the actor and the regulating authority. Quantitative rigid rules, however, reduce discretion and uncertainty as well as the regulator's administrative costs. These rules may be either over-inclusive or under-inclusive, either deterring more or less than what is optimally required. There should theoretically exist regulatory rules that "…there is an optimal specificity for any given standard where the administrative costs are approximately equal to the costs of any potential mismatch" (Ogus, 1994:169). While it should be a regulatory imperative to ensure that rules implemented upon a specific environment (such as equipment authorisation) should strive to achieve this optimal theoretical specificity, it may prove to be much more challenging in a real-world environment.

2.10 Regulation and unique challenges of developing countries

The focus of various studies in developing countries has been the effect of deregulation on competition in the sector. Makhaya and Roberts (2003) argue that privatisation and liberalisation in the South African telecommunications market as a whole have led to effective competition. This conclusion may, however, be questionable, given the fact that the incumbent fixed-line operator has since admitted abuse of its dominant position at that time. They do note that the capabilities and skills required by the regulator to regulate such a market are relatively scarce, coupled with informational asymmetries, where the regulated entity has more market information than the regulator (Makhaya & Roberts, 2003:43). Although this study is valuable in highlighting the challenges of a regulator in a developing country, it does not provide direction regarding a specific approach to EA regulation in developing countries.

Wellenius (1977) looks at the some of the unique challenges of developing countries:

i) Network roll-out

Network operators in developing countries may not be able to keep up with the demand for telecommunications services at cost related prices due to high growth rates in these markets. This then impacts their ability to grow their networks, which in turn negatively affects their financial sustainability. Telecommunications companies in developing countries are thus faced with several institutional and financial inadequacies. Wellenius (1977:294) also makes a point that challenges the much-researched view on the link between telecommunications and development. The consensus in academic literature states that telecommunications has a positive impact on economic growth (as discussed in detail elsewhere in this study). The challenge for developing countries is that a significant portion of the population lives in rural areas. Operators following an economically sustainable network roll-out model would generally target urban regions with a high population density to realise the highest financial returns (Wellenius, 1977:294). Rural installations will thus classically be subject to an initial loss, should the operator be obliged to roll out services through regulation in these areas. The overall profitability and network growth are thus different for developing countries when compared to developed countries. Rural installations, although critical in terms of a public interest perspective, does not drive technology adoption. Goolsbee and Klenow (2002) show that only a dense urban population with access to an extensive telecommunications network are the key drivers of technology innovation and adoption. Innovation and technology are well known to be the main aspects in driving economic growth, hence developing countries have a complex relationship between driving public access objectives and achieving economic growth.

ii) Education

The level of education of the general populace in developing countries is lower than that of developed countries. Telecommunications companies in developing countries are thus at a distinct disadvantage when compared to developed countries, as they do not have easy access to a pool of high-skilled human resources (Wellenius, 1977:295). This is especially pertinent to the engineering and management resources necessary to ensure an efficient and effective operator.

iii) Local telecommunication manufacture

Although developing countries may have a cheaper level of labour costs and raw material costs, the technology independence and maturity of developed countries make the local manufacture of telecommunications equipment in developing countries a difficult proposition (Wellenius, 1977:296). The research and development ability in developed countries act as a barrier to entry in the telecommunications manufacture market to developing countries.

In a study of 86 developing countries, Gasmi and Virto (2010: 285) have shown that countries faced with higher institutional risk and tighter financial constraints are more likely to promote policies that encourage investment, with the intention of extracting maximum revenue through licence fees. This regulatory approach in developing countries highlights the dominance of an economic perspective rather than a public interest perspective to regulation.

2.11 Diffusion of innovation theory, innovation policy and the importance of effective EA regulation for innovation

Theories of innovation and trade can be traced back to Romer (1987), but the underlying theory of the diffusion of innovation dates back to 1962 (Roger, 2003). This theory defines how innovation is taken up within a social system, with a focus on the time taken for the diffusion and the communications channels used. The proposed innovation would have to demonstrate a relative advantage over the idea that it supersedes, which could be expressed in a social or economic context (Roger, 2003). Santacreu (2015:1) links innovation to the growth and shows that technology adoption accounts for 65% of growth in a developing country, while 75% of the growth in developed countries is due to domestic innovation. OECD (2012:6) presents a stark example highlighting the effect of innovation on economic and social development. A comparison is made over a four-decade period of two developing countries, Ghana and Korea. The GDP per capita of Korea grew by orders of magnitude as compared with Ghana, which essentially remained stagnant. This growth in the GDP of Korea is attributed primarily to innovation in technology-related fields.

Innovation theory is closely linked to both social and economic theory, where innovation has been shown to positively impact both a country's GDP and social development as described in the example previously. The OECD (2012) report specifically lists flexibility of governmental policies as a key determinant in ensuring that developing countries take advantage of the benefits brought on by innovation in the digital economy. Regulatory innovation to support such policy flexibility would thus also be required to ensure that economic and social development can be accelerated in developing countries. This policy and regulatory support through innovative regulation would thus create an enabling environment that supports the development of technology (OECD, 2012:8). Chandra (2006) makes the distinction that developing countries, in particular, must innovate through policy initiatives to drive economic development. She cautions that although there are many examples of failed attempts by government to drive innovation and economic growth through policy reform, history has shown that government policy initiatives have still played a crucial role in driving innovation and growth in almost every successful country researched (Chandra, 2006:1).

The Porter *et al.* (2002) scale by which countries are categorised in terms of their economic development stages discussed earlier, is of relevance once more. Developing countries are generally at a factor-driven stage, characterised by the trade in natural resources and the use of unskilled labour. Chandra (2006) lists the example of two sub-Saharan Africa countries characterised by markets driven primarily by the production of primary goods created using semi-skilled labour. These countries adopted technologies innovated in developing countries, which led them to diversify their primary economic output to manufactured goods created by a skilled workforce. This remarkable transition occurred over a relatively short period of two decades, based on the adoption of technology that took a century to develop in the west (Chandra, 2006:3). This example illustrates the benefits of innovation to developing countries from an economic point of view.

We can thus see a direct link between innovation policies (including regulation) and technology innovation. This link is of particular importance to the EA environment which is a technology-driven environment. Innovation in regulation could lead to innovation in the technology of the equipment being offered in a country. As the OECD (2012) report states, the prime consideration would be to create an enabling environment for the adoption of new technology. This need not necessarily be limited to innovation that is unique and local, but rather to tap into "the globally available knowledge and technologies and adapting them to local contexts" (OECD, 2012:7).

Innovation policy complements innovation theory, in that it focuses on policy and regulatory objectives that remove obstacles to innovation. Innovation in this sense refers to something that is new to that particular market and not necessarily new to the world (World Bank, 2010). Innovation policy is of particular importance to developing countries as the adoption of foreign technology can play a significant role in incremental innovation (OECD, 2012:118). Innovation theory and innovation policy thus form a valuable perspective to this study, given the fact that South Africa is largely an importer of EC equipment (WTO, 2014). The EA regulatory approach would have a direct bearing on innovation by promoting either an import driven technology growth or a domestic equipment manufacturing industry. An efficient and innovative policy approach to EA would need to ensure that regulatory obstacles to innovation are removed.

An excellent example of innovation within the context of equipment authorisation frameworks would be the previously discussed Carterfone decision of 1968 promulgated by the FCC in the US. This regulation is regarded as the fundamental consumer rights decision in the history of communications, arguably even recognised as the central tenet of all competitive telecommunications policy decisions (Wu, 2007:397). The implications of this ruling were substantial, impacting even the economy of the US as a whole. Moreover, this decision is recognised to have led to a slew of associated innovations in the telecommunications industry, most notable being the fax and answering machine as well as the modem. The socio-economic impact of the internet on modern society is well documented and can be attributed to this policy decision as well. Without such enlightened policy decisions of the time, it is doubtful that innovation could have occurred at such a rapid pace that we observe today. The Carterfone regulation removed bottlenecks to innovation and decentralised innovation (Wu, 2007:398). There is however conflicting research that shows that a high level of innovation due to competition exists in the wireless market, thus regulation in this market would not be appropriate (Faulhaber & Farber, 2010). What is clear though, is that innovation is inexorably linked with EA policy, whether it supports a deregulated model or a regulated one. There are, however, conflicting views regarding the deregulated model. Howard and Mazaheri (2009) argue that too little regulatory or policy oversight can have a negative effect on technology adoption and may exacerbate the digital divide. Their approach recommends an independent regulator that enters into public-private relationships to develop national communications infrastructure as the ideal solution (Howard & Mazaheri, 2009:1159). The challenge for developing countries to implement policies that grow the economy thus becomes more demanding and further supports the position that the theoretical approach to EA regulation in developing countries should be tailored to that country.

A possible drawback to innovation policy is that it is a holistic approach to government policy and intervention. The "whole of government" approach (OECD, 2012:10) means that only a focused and coordinated effort by government would yield results such as those cited in the Korean example earlier. While this may be regarded as the ideal approach to drive innovation in a developing country, it does not necessarily detract from possible gains that may be achieved via a more fragmented approach, such as focusing on specific regulation. Innovation in EA regulation as an example could be the starting point for a regulatory overhaul, which can be later supported by other complementary governmental policies. The World Bank is supportive of adapting regulatory frameworks and lists specific rules that govern technology imports (World Bank ,2010). EA is such a regulatory environment that governs new equipment technology innovation in a country, by either prohibiting or allowing the use of new EC equipment in a particular country. The approach to such technology imports suggested by the World Bank (2010) as well as the OECD (2012) would be to set performance standards for technology equipment, rather than setting technical requirements. This approach is consistent with the discussion around the types of standards (either design or output standards) discussed earlier in the research. This endorsement of performance standards or output standards is driven by increasing trade and driving economic benefit, which thus aligns itself with a more economic theoretical approach. There is very little mentioned in the literature surveyed that links innovation policy to the promotion of the social agenda. It would seem that innovation policy, at least within the context of EA regulation, would drive social considerations indirectly only, via the gains that are evident through an increased GDP of a particular country. Innovation policy could thus be essentially considered as only an economic-focused approach.

2.12 New trade theory, trade policy and the importance of effective EA regulation for trade

New trade theory is predominantly concerned with international patterns of trade and economies of scale. New trade theory suggests that governments have a critical role to play in facilitating trade and promoting the growth of key industries (Krugman, 1989). Trade policy is an instrument that responds to concerns relating to non-commodity outputs with localised effects or international trans-boundary effects. The localised policy would have little effect on trade, while the trans-boundary policies can impact trade significantly (Tothova, 2009:5). This is of particular importance to this study as the theory promotes free trade and *laissez-faire* government intervention as a mechanism for developing countries to be able to compete in a world market. This approach is purely from an economic viewpoint and does not address the public interest considerations brought about by a light touch regulatory approach.

Edwards and Lawrence (2012:4) point out that if South Africa were to expand its economy by 6% per year, imports into South Africa would have to increase by double-digit figures. These numbers highlight the relationship between economic development and imports. As discussed earlier, South Africa is a net importer of EA equipment, and the linkage between imports, technology and innovation is an important one. To innovate, South Africa would have to have access to the latest technology which can generally only be imported. This once again is a process that is highly influenced by the EA framework.

Trade theory is further complicated when the context of developing countries are taken into consideration. Were (2015) argues that while there is considerable literature that consistently shows that trade has a positive impact on economic growth, its effect is not significant in developing countries. Although the research acknowledges the impact of trade on foreign direct investment, the structure and pattern of trade is the key determinant of economic growth. This structure and pattern of trade are unique to developing countries and once again contributes to the earlier discussion around the unique characteristics of developing countries. Trade in developing countries are hindered by high transactional costs brought about by institutional differences (non-uniform) between trading companies, bureaucracy and cumbersome border and customs procedures, poor infrastructure, limited human and physical capabilities and poor quality of institutions (Were, 2015:85). This decreases the competitiveness of the country and prevents it from maximising the benefits of trade. In terms of EA, the lack of uniform standards for equipment approval amongst developing countries in Southern Africa (as an example) is of particular importance. There is thus no avenue available to Southern African countries to leverage the economies of scale brought about by common standards when purchasing equipment for their countries. Also absent in the Southern African environment is the mutual recognition system, such as the R&TTE

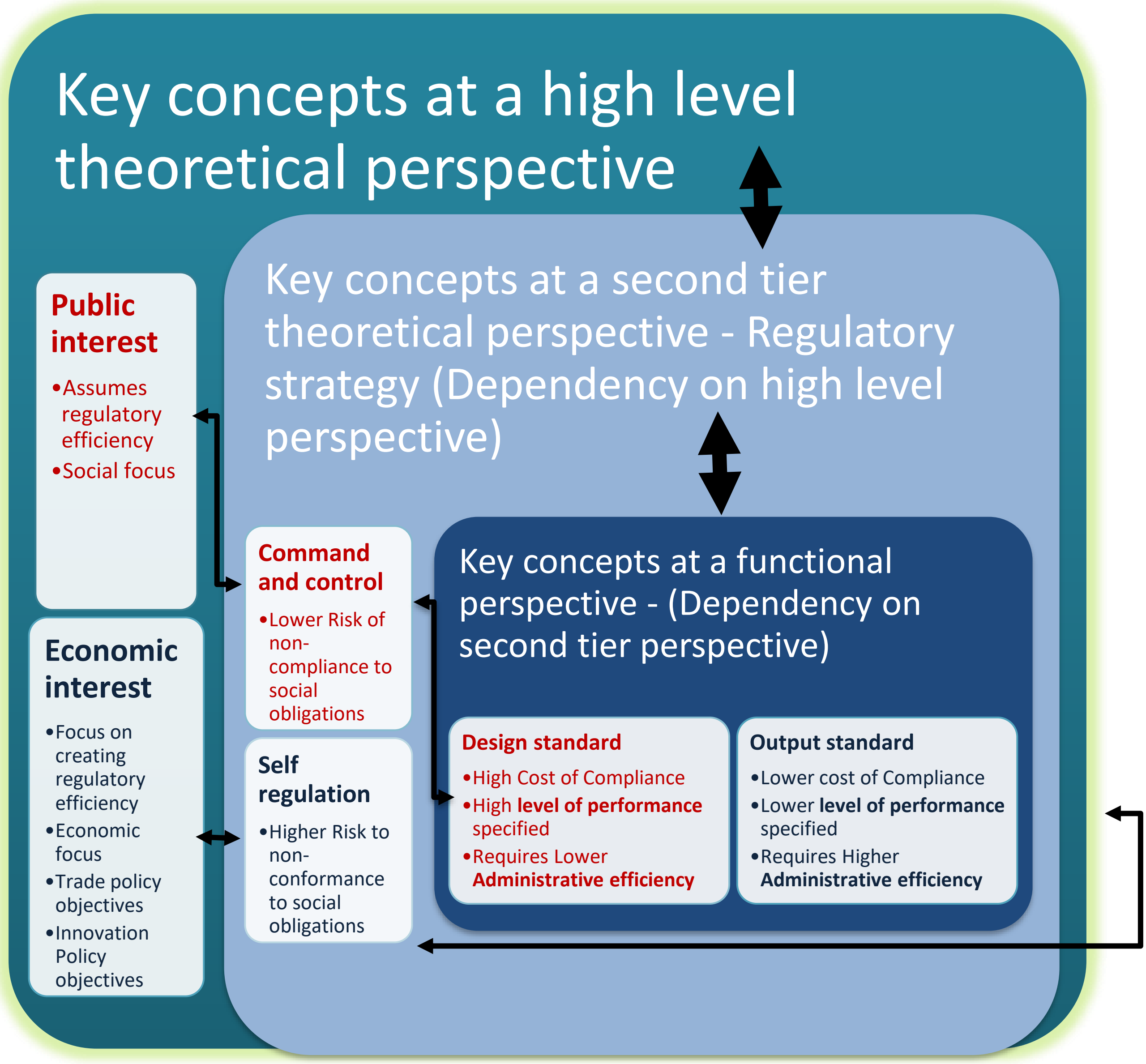
directive employed in Europe. Mutual recognition agreements also leverage on economies of scale when purchasing equipment, but more importantly, it eliminates the duplication of the EA process. The structure and pattern of developing countries in the context of EA are thus fitting examples of the bureaucracy and institutional differences endemic to developing countries. The absence of a mutual recognition system in Southern Africa thus negatively impacts inter-regional trade and thus economic growth in the region.

A significant drawback of trade policy for governments is the implementation of sectoral level policies. Edwards and Lawrence (2012:11) cite the iPod as an example, which although manufactured in China, has components sourced from around the world. Feenstra (1998) terms this process as the disintegration of the production process and makes an important point when he states that this disintegration of the production process leads to increased trade. The explanation put forward is that the intermediate inputs to the finished product could cross borders several times during the production process, leading to an increase in overall trade volumes (Feenstra, 1998:34). This global fragmentation of production is especially applicable to EC equipment and highlights the difficulty of trade policy, as the target for intervention is no longer the product, but the production process of the value chain (Edwards & Lawrence, 2012:11). This in turn leads to questions about the EA framework and its impact on driving trade and thereby innovation. Given the dynamic nature of the EC market and the rapid pace of technology, EA frameworks may not be able to promote trade effectively and could even be considered a barrier to trade. In this respect, the proven economic gains brought about by innovation and trade would need to be carefully weighed up against the social considerations of health and safety.

2.13 Theoretical framework and conceptual framework for EA regulation

In developing an innovative theoretical approach to EA regulation, the current theoretical perspective would have to be considered. The key theories of note to the study at this stage, are the public interest theory, regulatory strategy theory and the economic theory of regulation. An ideal scenario would be to determine the intersection of the two theories (public interest and economic theory of regulation) in the EA environment to determine a level of performance that can be set at an appropriate level for a developing country using the appropriate type of standards, without comprising the safety or operation of the equipment by decreasing the cost of proving compliance. These almost opposing requirements inform the design of the study as there is a need for new theoretical explanations built on previous knowledge to explain changes in this field. The key concepts of the study are therefore by-products of the theoretical framework. These concepts are public interest, economic interest, command and control, self-regulation, design standards, output standards and level of performance, forming the lens by which the limitations of the current regulatory approach will be assessed and are expressed (see Figure 7).

Figure 7: Theoretical and conceptual framework of the study



The key concept from the public interest theory is public interest and the key concept from the economic theory of regulation is economic interest. These form the high-level theoretical perspective that frames the EA regulatory environment, as they determine the approach to regulation based on either public interest or economic principles.

The concept of public interest assumes that regulation can efficiently take care of the public interest. The key concept from the economic theory of regulation is that of economic interest, which focuses on ensuring that the cost of compliance is not overshadowed but the net benefit of the regulation. It also looks to ensure that regulation is efficient with the lowest cost of compliance, while conforming to innovation and trade policy objectives.

The next tier is a second level theoretical perspective, which is dependent on the first, as it determines the regulatory approach adopted to regulate based on either a social or economic approach. The command and control strategy follows a public interest perspective and has stringent requirements that need to be met before EA can be granted. These requirements come at a high cost, but ensure that the social aspects of regulation are adhered to (e.g. the health and safety considerations). It does not focus on the actual cost of compliance to gauge whether the net effect of the regulation is more burdensome than helpful. The self-regulation strategy has far lower compliance costs due to the less restrictive regulations. There is a lesser onus on the EA manufacturer to conduct tests and provide proof as there is with the command and control structure. There is, however, a risk that the social obligation may be ignored to lower the administrative costs of compliance, thereby endangering health and safety. An added complexity to consider is that the lower administrative costs would result in lower equipment prices, which may be passed onto the end user. This perspective then supports a public interest approach as it makes equipment more accessible in terms of costs to the general public.

The final tier is at the functional level and defines the type of standards that are required regarding command and control and self-regulation strategies. The functional tier is again dependent on the on the previous tier to chart the type of standards adopted. Command and control strategies employ design standards in general, which specify the way that the equipment has to be manufactured in order to comply with the social aspects. Command and

control could also employ output standards. These would be EMC standards in the EA environment, where the EMC emissions are regulated.
Design standards can be onerous to comply with and provides a high level of administrative burden on the supplier of EA equipment. The self-regulation strategy employs output standards as a measure of compliance. These standards place the burden of proof onto the regulator, which decreases administrative costs substantially for the equipment manufacturer. These types of standards are the real-world interventions that are ultimately a derivative of a theoretical approach to regulating EA.

The final concepts would be the level of performance and administrative efficiency, the magnitude of which is dependent on the type of standards applied. This conceptual framework will underpin and form the foundation on which research is conducted to create an innovative theoretical approach to EA regulation.

3 Research methods

This section aims to give an overview of the methods that were used for this research, as well as detail the actual research design.

3.1 Overview of the methods

There are competing approaches to social research based on the philosophical assumptions about the purpose of science and the nature of social reality (Neuman, 2006:104). To adequately address the problem statement of this research, a qualitative research paradigm was adopted. Babbie (1994:370) describes a qualitative analysis as one that "involves the non-numerical examination and interpretation of observations, for the purpose of discovering underlying meanings and patterns of relationship". A qualitative research paradigm intends to understand a particular social situation via an investigative process, where "…the researcher gradually makes sense of a social phenomenon by investigating the object of the study". (Creswell, 2003:198). The social situation explored in this instance is the applicability of the current theoretical approach to EA regulation in a developing country.

3.1.1 Research question

The research method details the process used to elicit data required to answer the research question:

In which ways can innovative theoretical approaches to regulation be applied to the EA regime of a developing country such as South Africa, in order to address the limitations presented by the current theoretical approaches?

The research question implies that the current theoretical framework is limited in South Africa and empirical data from experts knowledgeable in the EA field is required to generate an alternative substantive theory. Substantive theory assists the researcher in developing a theory that is specific to an empirical area of study (Charmaz, 2006) and is not generalisable. An exploratory qualitative research paradigm was best suited to elicit the required data for this study. Although there was an element of document research, interrogation of EA experts was essential to generate an innovative theoretical perspective grounded in the data collected. For this reason, a grounded theory method was selected for this research.

3.1.2 Grounded theory method for developing innovative theoretical approaches to EA

The preceding chapters have shown that the current theoretical approach to EA authorisation has limitations in terms of the public interest and economic theory priorities . A qualitative grounded theory methodology was chosen by the author to develop an innovative theoretical approach to EA in a developing country like South Africa. Grounded theory is a widely used qualitative research methodology that the author believes would be best able to address the research purpose and questions, as the extant theoretical approaches to EA regulation have several limitations, and are possibly not appropriate to a developing country like South Africa. Grbich (2007:70) suggests that grounded theory methodology is appropriate "when there is a need for new theoretical explanations built on previous knowledge to explain changes in the field". This view is supported by Charmaz (2006:5) who states that "…grounded theory advocates developing theory from research grounded in data rather than deducing testable hypotheses from existing theory." This statement fits well with the research conducted here, as the specific theory for a specific circumstance (an innovative EA theoretical framework for a developing country) is built using the conceptual framework designed earlier in this research – but not on it. Charmaz (2006) further notes that the grounded theory researcher looks for a fit between the emerging data and the initial research, but does not force these original ideas and theories onto the data. The theories that underpin EA thus do not define the output of the study, as the study proposes an alternative theoretical framework determined by the data collected during the research process.

Strauss and Corbin (1998) define grounded theory as a "qualitative research method that uses a systematic set of procedures to develop an inductively derived theory about a phenomenon". Babbie (1994:291) proposes a definition that describes the mechanism of analysis employed by grounded theory as "…the attempt to derive theories from an analysis of the patterns, themes and common categories discovered in observational data". Charmaz (2006:4) best describes the end product of grounded theory as having an abstract theoretical understanding of the studied experience. The research logic process is thus an inductive one.

Glaser (2009:1) suggests that grounded theory is ideal for a novice PhD researcher, as they can see new patterns from the data that more experienced researchers may miss. Glaser (2012:5) makes an important statement of grounded theory when he states the objective of grounded theory as one that generates a theory within the chosen data boundaries. It does not create a new formal theory if the researcher limits his theoretical sampling and theoretical completeness within a specified population. This definition is relevant to this research, as the objective is to create a theory that is cognisant of the current theoretical approaches but is specific to the population of an EA regulatory environment of a developing country. The real strength of grounded theory lies in its open-ended approach to discovery (Glaser, 2012:5), which is used to good effect in this research as it relies on discovering an innovative theory that is faithful to the environment of a developing country.

3.2 Research philosophy

The research method gives to "How" any study would be conducted, but it is equally important to decide the "Why" such a study was undertaken. That "Why" is the research philosophy.

Overall, Postmodernism and Critical Theory is the interpretative framework adopted in the research, as the ontology of the EA environment in a developing country cannot be assumed to be fully understood, given the range of viewpoints and perspectives of actors in the environment. To that end, several subject experts in the EA field were interviewed to give a broad spectrum of perspectives from people in this sector. The basic concept of postmodernism "…is that knowledge claims must be set within the conditions of the world today and in the multiple perspectives of class, race, gender and other group affiliations" (Creswell, 2012:27). This interpretative framework fits well with the constructivist approach to grounded theory advocated by Charmaz (2003). Charmaz's approach to grounded theory is reflective of a post-modernistic view and provides a modern alternative to classical grounded theory. Charmaz (2003:250) looks to provide more accessible methods of grounded theory for taking qualitative research into the 21st century. Post-modernism was used to describe an environment where scholars had not yet found a clear, specific description of the "knowledge-based" economy, including knowledge for the digital economy. As this study is focused on research problems typical of the digital era using the grounded theory method, a post-modernistic view is appropriate.

Critical Theory advocates social research that critiques society as a whole, to provide a deeper understanding of the processes that form human texts and symbolic interpretation (Horkheimer, 1982). Critical theory encourages reflective thinking and relates well to the constructivist approach to grounded theory, in that multiple views of social reality has to be considered. These views require "…an interpretative understanding of the subject's meanings" (Charmaz, 2003:250) which is possible using critical theory and is complementary to the post-modernistic interpretative framework of this research. Data and analysis are co-constructed from the interaction of the researcher and the research subject, which is very much a post-modernistic view of qualitative research and is also supported by a reflective understanding of the processes guided by critical thinking. With this frame of reference adopted in this study, several philosophical assumptions are made.

The approach to the philosophical assumptions that shape and direct this study are adapted from the description of the four philosophical assumptions by Creswell (2003).

3.2.1 Ontological assumptions

Ontological assumptions are the "idea of multiple realities and report on these multiple realities by exploring multiple forms of evidence from different individuals' perspectives and experiences" (Creswell, 2003:20). This study explores innovative theoretical approaches to EA regulation. As such, the nature of the knowledge or the ontology is subjective, with multiple realities from the perspective and experiences of the many respondents that were interviewed.

3.2.2 Epistemological assumptions

Creswell (2012:20) defines epistemological assumptions as the relationship of the researcher to the research. The researcher in this instance is an employee of the regulator and is involved in the day to day operation of the subject matter. There is thus very little "object separateness" (Creswell, 2012:20) between the researcher and the subject being researched. This epistemological approach is advantageous to the researcher in this study, with regards to grounded theory. Grounded theory dispels the positivist notion of being a passive observer in the research process as the researcher becomes part of the research process, being immersed in the collection as well as the interpretation of data (Charmaz, 2006: 23). The guidelines and regiment of grounded theory, however, assist in providing checks for both data collection and analysis, to ensure that the data and findings are valid and reliable.

3.2.3 Axiological assumptions

Axiological assumptions describe the values of the researcher in the research, where "Researchers make their values known in the study and actively reports their values and biases as well as the value-laden nature of information gathered from the field" (Creswell, 2012:20). As discussed in the previous section, the researcher fully declares his association with the subject of study and ensured that any personal values or bias was actively declared.

3.2.4 Methodological assumptions

Given that the grounded theory method is the research method adopted for this study, a largely inductive mechanism is adopted. Grounded theory formulates theory from a given point, and does not test existing theoretical ideas. As such, reasoning in an inductive direction is the desired goal and thus the epistemology of the EA environment is studied inductively. Neuman (2006) defined inductive reasoning as "…observing the empirical world and then reflect on what is taking place, thinking in increasingly more abstract ways, moving toward theoretical concepts and propositions" (Neuman, 2006:60). The empirical world in this study is limited to the EA regulatory environment in South Africa.

The unit of analysis, the "what or whom" being studied (Babbie, 1994:94), is the approach to EA regulation in a developing country like South Africa. This regulatory approach is the individual unit that descriptive and explanatory statements are made about. The EC EA theoretical framework has a significant impact on the social reality of South Africa, and it is this impact that this study explores.

3.3 Data collection for a grounded theory study

The data used in this study is obtained predominantly from primary data sources. Badenhorst (2007) describes primary data as one that carries the authority of the real world. It provides the empirical proof required by the researcher. The data collected using the research design as explained earlier required a mechanism to gather and measure the data. Two types of research instruments are used to provide the requisite data for this study. The predominant instrument is the in-person interviews with the identified respondents as well as a concurrent process of document analysis as a secondary source of data. These are starting points for data gathering, for as Charmaz (2006:16) points out, "The logic of grounded theory guides your methods of data-gathering as well as of theoretical development". In other words, the process of gathering rich data opened other possibilities to gather data, which was not evident from the outset of the research. Examples include the various additional legislative documents concerning standards, which were brought to the researcher's attention during the interview process.

The types of data that were gathered relate directly to the three sub-questions of the research. The data required is presented per section, to detail the type and source of the data. Reasons are also presented to justify the choice of informants in generating the necessary data. The research instrument to gather the data is then suggested.

3.3.1 Data gathering on limitations of the current theoretical approach

The first type of data collected is evidence to the extent that the current theoretical approach to EA regulation is limited. The data collected was used to confirm the initial analysis conducted in the study, which show the real-world problems associated with the current regulatory approach to EA regulation.

a) Document analysis

The initial source of data collected was through document analysis. A wide source of records was considered. Preliminary interviews with the principal actors in the EA environment (discussed next) was used to probe for further sources of document analysis.

An important source of document information was the ICASA EA application files. A sample of 50 EA applications over the years 2010-2017 was originally planned for analysis. However, after reviewing the first ten files, it became apparent that these files contained a "sanitised" version of the EA process and did not provide the type of rich data required for this study. I then requested the various informants that I had interviewed to provide me with a written record of their correspondence during their EA approval journey. This proven to be a rich source of information, as it contained a historical record of the EA query, and in many instances articulated the range of interactions conducted by the participants during an EA application. This data provided a closer representation of the EA process, as the EA application files did not capture delays, queries, questions and complaints.

Some EA applications were still reviewed as well. It would have been ideal to have access to files over a ten year period, from 2006 to 2016, however, files before 2010 could not be easily accessed as they had been archived. Access to these archive files was restricted to staff members of the type-approval department. The records from 2010 onwards were still valuable and provided a second subset of data that provided accurate information on the limitations of the current EA framework. Some key areas examined were:

i. Comments regarding the processing time of EA applications.
ii. Admin processing comments and observations of EA applications.
iii. Technical process comments and observations of EA applications.
iv. Comments made by the administrative officer regarding delays.
v. Informational deficiencies related to test reports.

vi. Costs and comments relating to the cost of the EA process made by the applicant.

vii. Complaints or other comments made either by the applicant or ICASA staff.

ICASA annual reports were studied for statistics on illegal equipment and the numbers of equipment authorisations in the years 2006-2016. These documents were also reviewed to gain an insight into the overall regulatory approach that ICASA had adopted to regulation in general. Relevant Acts, policy documents, relevant speeches and regulations applicable to EA were analysed to gauge the high-level intention of the current policy and regulatory framework. Relevant policy documents regarding the digital economy were analysed, again with the intention to understand the high-level policy direction. The complete list of documents analysed can be found in Appendix C.

Glaser and Strauss (1967) list document analysis as a useful source for theory formulation and state that it provides "…a fantastic range of comparison groups, if only the researcher has the ingenuity to discover them" (Glaser & Strauss, 1967:179). The documents analysed were coded to determine initial codes and categories. These codes and categories were then used to form the basis of preliminary discussion during the interview stage of data collection.

b) Data gathering on unique characteristics of developing countries

The second set of data that is required was information on the unique characteristics of developing countries, in the context of EA regulation. This was gathered via in-person interviews.

c) In-person interviews

The researcher formed the primary instrument in data collection, using a semi-structured in-person interview protocol, whose output data was descriptive in nature. The main purpose of using a semi-structured design was to facilitate a digression from formulaic questions, allowing the researcher to explore further concepts that may unexpectedly arise. These concepts may have not necessarily been covered in the interview questions and may be essential to the research at hand. Glaser (1998) cautions against preconceived interview guides and suggests using open-ended questions that prevent responses from interviewees being forced into narrow categories. The interview questions were thus open-ended, ensuring that only rich, substantial data was gathered. Charmaz (2006) describes this data gathering mechanism as "intensive interviewing" and states that it provides "…an open-ended, in-depth exploration of an aspect of life about which the interviewee has substantial experience, often combined with considerable insight" (Charmaz, 2006:29). Hofstee (2006) has similar views when he describes the interview method as appropriate for eliciting information from people who are presumed to have the information that is required for the study. The informants interviewed (as detailed in Table 1) are those closely involved in the equipment authorisation process in South Africa and were thus the most appropriate people to provide the required information on the EC EA process.

The interviews were used to focus on the interviewees' perceptions, challenges and experiences in a developing country. These interviews were written up into interview transcripts, from which the coding process using grounded theory was implemented.

A Skype interview was only used in one instance, where the respondent was not available for an in-person interview. All other interviews were face-to-face.

A pilot of the in-person interviews using five respondents was considered but was not implemented. The rationale for such a pilot was to correct problems with the interview guide. It is important to note that, given the use of the grounded theory method, a pilot is not essential. Grounded theory calls for simultaneous data collection and data analysis (Glaser, 1998; Charmaz, 2006). This implies that problems with the interview guide can be picked up after the first interview. The pilot adopted in the research can thus be considered as initial interviews, where the interview guide was reassessed and edited to counter problems experienced after the first few interviews. The first interview revealed that the interview guide was too long (resulting in an almost four-hour long interview) and it was subsequently amended by limiting the number of questions. The second interview revealed possible duplications in the questions, depending on whether the guide was followed throughout the interview. In this instance, however, the interview guide was not amended, although the researcher was mindful of the informant's responses and did not ask certain questions if the informant had already volunteered the required information.

3.3.2 The population sample selected for in-person interviews

Creswell (2003:185) found that "purposefully selected sites or individuals" would be able to help the researcher understand the problem and research question. For this reason, the interviewed sample did not necessarily represent the general public as a whole and thus presented a skewed sample of the population. This is acceptable as a particular sample of the population was purposely targeted, as they were best able to contribute to understanding the research questions at hand, being stakeholders in the equipment authorisation process in South Africa. Babbie (1994:185) describes this sample as "Selecting Informants". Informants are people who are well versed in the social phenomenon that one wishes to study and are also willing to inform the researcher of the knowledge that they possess (Babbie, 1994:185). The significant differentiation between informants and other respondents is that informants can talk directly about the industry that they work within. All informants selected were 18 years or older, and their identities were kept confidential, to ensure that they were able to contribute to this research without fear of reprisals freely, should their opinion not necessarily reflect an "official" position of the organisation that they may represent. To further ensure confidentiality, all references to their names have been coded randomly to enhance their anonymity. During the research period, these codes were linked to the informant's name and initials to assist the researcher in easily identifying and assigning quotations and data from the informant. After the data chapters were complete, these codes were anonymised using the find and replace function of Microsoft Word.

Charmaz (2006) provides a useful guide containing questions that the researcher should ask when selecting the informants. The idea is to gather rich data, which is data that is not superficial and can provide depth and range to the research. The following questions are suggested by Charmaz (2006:19):

i. *Have I collected enough background data about persons, processes, and settings to have ready recall and to understand and portray the full range of contexts of the study?*

   This was achieved by first conducting the document analysis. The document analysis assisted greatly in defining the initial range of interviewees. Each interview opened up new areas of interest and sometimes directed the researcher to consider other sources of data. These were both documents and other people within the EA environment that were not taken into account when the initial range of informants was identified.

ii. *Have I gained detailed descriptions of a range of participants' views and actions?*

   The concern raised in this question was addressed by the use of an open-ended interview protocol. As much as Glaser (1998) cautions against the use of interview guides to prevent forcing responses into preconceived categories, the interview protocol was used to guide the particular direction of the research. The research question and the three sub-questions were used as broad categories to guide the interview direction. This approach was adopted to guard against the danger of gathering data in a particular area of interest to the detriment of other areas. The interview guide ensured that the open-ended question approach adopted, allowed for detailed descriptions from participants. The interviews were recorded and transcribed in depth to ensure that the participant's views and actions were captured in detail.

iii. *Do the data reveal what lies beneath the surface?*

This was possibly one of the more challenging questions to answer. The data gathered was based at a practical level, given the interviewee's predisposition on providing examples and responses based on their day to day interaction with the EA environment. The aim of this study as discussed previously was to create an innovative theoretical framework, based on the practical considerations of the EA environment. Only through repeated analysis and comparison, could the required level of abstraction be achieved. The value of the data collected could therefore not easily be immediately assessed as being representative of the underlying issues. To mitigate this concern and to ensure that the line of questioning delved deeply beneath the surface of superficial responses, the researcher had to ensure that key points and issues were further investigated. Responses that are described as "flags" in this research were followed up to make sure that a deeper understanding of that particular "flag" was achieved.

iv. *Are the data sufficient to reveal changes over time?*

The initial research, before the formal research was conducted, was able to provide several trends in EA approval over time. Further document analysis assisted in providing a greater level of clarity, by illuminating the key issues that underlie these patterns. These key issues reflect changes over a period of more than a decade. The subsequent interviews, as well as the interview guide, were then guided by the initial research and ensured that the data was sufficiently representative of an extended period.

v. *Have I gained multiple views of the participants' range of actions?*

The significant process in this study is the EA regime in South Africa. This process involved several participants engaged in a multitude of actions. The process was investigated in multiple dimensions, as viewed by each participant. For example, the application procedure for EA is a process that involved network operators, the regulator, equipment suppliers and test laboratories. This particular action was studied through multiple views from different informants. Adding a further dimension to this process was that each category of informants consisted of, at times, several participants who each provided a different viewpoint to that particular action. The regulator, for example, consisted of several people who were involved in a particular action of the EA application procedure, providing viewpoints from an administrative to a technical point of view.

vi. *Have I gathered data that enable me to develop analytic categories?*

The depth and degree of questioning are the only factors that can positively affect the outcome of generating analytical categories from the data gathered. To ensure that the type of questioning elicited rich data, the guide suggested by Charmaz and Mitchell (2001) was adopted. This guide is discussed further in the next section, although of importance is the focus on asking “Who, What and Why” questions to elicit detailed responses.

vii. *What kinds of comparisons can I make between data? How do these comparisons generate and inform my ideas?*

The memos generated after the interviews were critical. These memos contained the relevant codes that were observed from the data gathered and assisted in conceptualising categories. Both the memos and the codes therein were used to make comparisons with other memos generated at different stages of the data gathering process.

The following informants in Table 1 were identified as the most appropriate to gather the rich data required for the study.

Table 1: List of informants

No.	List of Informants
1	Manager: Type Approval (ICASA)
2	Senior Licensing Officer (ICASA)
3	RF Specialist (ICASA)
4	RF Specialist (ICASA)
5	RF Specialist (ICASA)
6	Engineering Executive (ICASA)
7	Regulatory Affairs (Operator 1)
8	Regulatory Affairs (Operator 2)
9	Regulatory Affairs (Operator 3)
10	Regulatory Affairs (Operator 4)
11	Regulatory Affairs (Operator 5)
12	Equipment Supplier 1
13	Equipment Supplier 2
14	Equipment Supplier 3
15	Equipment Supplier 4
16	Equipment Supplier 5
17	Equipment Supplier 6
18	Equipment Supplier 7
19	Standards Specialist 1 (SABS)
20	Test Laboratory Representative 1 (SABS)
21	Test Laboratory Representative 2
22	Industry Forum Representative 1
23	SM Licensing ICASA
24	GM Licensing ICASA
25	Policy Maker (Government) 1

3.3.3 The types of data gathered from the in-person interviews

The types of data collected from the in-person interviews were based on a guide adapted from Charmaz and Mitchell (2001). It should be noted that this guide was suggested for an ethnographic study by Charmaz and Mitchell (2001), but the basic principle behind these guidelines are valid for any qualitative. These guidelines were adopted in creating the interview guide and helped generate the different types of open-ended questions:

i. *What is the setting of the action? When and how does the action take place?*
   The interview guide set about by first grounding the action in the EA environment, including a description of EA in South Africa within a specified period from 2006 - 2016. The key processes in the EA environment were also identified and the mechanisms defined. The process was described by different actors involved in the same activity, assisting in ensuring multiple viewpoints.

ii. *What is going on? What is the overall activity that is being studied, the relatively long-term behaviour about which the participants organise themselves? What acts specifically compromise this activity?*
   Generating questions to elicit the above, was not a straightforward process. The "what" refers to the deeper social and physiological processes that are occurring within the environment of study. Glaser and Strauss (1967) call for the basic social process to be defined in the field, and rate this definition as fundamental to the grounded theory method. More contemporary approaches to grounded theory suggest that this approach may lead to "forcing the data", and this method was abandoned (Charmaz, 2006: 20). The interview guide, therefore, did not seek to define the social process implicitly. The act of regulation itself was explored further, in terms of the overall intention of the regulation -i.e. either a public interest approach or an economic approach. This assisted in framing the research regarding the extant theory but was not used as a basis to force a particular category into the data gathered.

iii. *What is the distribution over space and time of participants over this locale?*

The interview guide grounded the focus of data collection to a fixed period and category. Although this research was intended to apply to developing countries in general, the data gathered was limited to the South African environment. It became apparent during the interviews that participants saw South Africa as a unique market, bordering between a developed and developing country concerning the EA environment. The aim was to develop a substantive EA theory in the South African environment. The research was grounded in South Africa based on the empirical data collected. An increased distribution of participants may have assisted in providing a general theory, but is beyond the scope of this study.

iv. How are members stratified and how is membership achieved and organised?

This interview guide determined the organisation of the EA market in terms of suppliers, operators and the regulator. This approach clarified the key players and their expectations regarding EA regulation. The stratification process was also necessary as there were further organisational tiers within an identified area. As an example, the equipment supplier market was further broken down into the original equipment manufacturers and suppliers of equipment. This nuanced distinction was important to define, as the expectation of each group in relation to a regulatory approach varied.

v. What do actors pay attention to? What is important, preoccupying, and critical?

The interview guide focused in detail on the limitations of the current theoretical EA approach, by considering what the actors considered as critical to the success of a new approach, given the environment being observed. Some of the key codes developed early in this study were achieved by investigating the factors considered critical by actors. Constant comparison with data from different interviews was essential in creating the code-families and attaining a sufficient level of abstraction when defining the key categories. Processes deemed critical by informants provided a perspective from their particular viewpoint, hence the key categories developed through multiple points of view yielded rich data. The downside of the process was an increased area of focus. For example, after the initial interviews with the essential personnel dealing with the EA process at the regulator, other interesting areas of focus developed. This led to more questions being posed at the next set of interviews, without a decrease in the initial round of questions. As such, the length of each interview began increasing. The rich data that was gathered, however, outweighed the voluminous amount of additional material that needed to be processed.

vi. *What do the actors pointedly ignore that other persons might pay attention to?*
The guide focused on areas that actors ignore in the current theoretical approach, which may have importance to the broader EA environment. What some actors ignored sometimes proved more valuable than what was discussed. Once again, the perspective of the particular actor determined what they ignored. A good example was the concept of public interest, which was ignored by manufacturers and suppliers alike but was considered critical to the regulator as well as the policymaker.

vii. *What symbols do actors invoke to understand their worlds, the participants and processes within them, and the objects and events they encounter? What names do they attach to objects, events, persons, roles, settings and equipment?*
The guide looked at the common definitions in the EA process, to determine a commonly understood baseline for the epistemology of the EA environment. This assisted in the development of the initial coding by asking the informant to describe how they viewed specific processes. This added a level of complexity, as the process outlined by a particular actor using a particular symbol was in many instances explained differently by another informant. The constant comparison process assisted here, by comparing the codes and the implied definition, thereby allowing a generic category to be developed that best described that particular process.

viii. *What practices, skills, stratagems, and methods of operation do actors employ?*
The guide looked to determine the method of operation employed by all actors in

their day-to-day functions, given the current regulatory approach. Such activities were also defined by documents studied during the document analysis phase. These practical mechanisms were necessary for defining the unique characteristics of the environment under study, as the method of operation adopted by the actors were delimited by the considerations in South Africa. As an example, it was apparent that OEM suppliers had easy access to international test reports required for EA approval, while some local suppliers did not have access to these reports. The strategy adopted by the local suppliers was thus to apply for a simplified EA process, which did not require evidentiary reports.

ix. *What theories, motives, excuses, justifications or other explanations do actors use is accounting for their participation? How do they explain to each other, not to outside investigators, what do they do and how do they do it?*

The guide looked to determining the macro environment that exists for actors participating in the EA process. The question posed specifically looked to establish the motivation for actors to justify their participation, from an internal point of view. The idea was to identify an internal perspective, not just a company's "official line". This was difficult to assess when dealing with the suppliers and network operators, as their motivations were driven by their organisational perspective. The valuable data revolved around identifying an internal perspective, by probing informant's responses to strip away responses based solely on corporate culture. The stratification of the environment played a major role here, as it assisted in defining the motivating factors at different levels. The regulator and policy maker's motivations were simpler to gauge as they are based on published legislation.

x. *What goals do actors seek? When, from their perspective, is an act well or poorly done? How do they judge action-by what standards, developed and applied by whom?*

This guide looked at the expectations of the actors in developing an innovative theoretical approach. Their expectations regarding what would be considered an easier approach was framed against the way they would assess that approach. The success criteria defined by actors in terms of what they would consider an innovative approach to EA regulation, varied by the motivation of each actor as described earlier. This question also looked at the limitations of the current approach and was also used to probe alternative approaches that the actors would consider innovative and successful.

xi. *What rewards do various actors gain from their participation?*

The final area of inquiry looked at the reward derived by the actors in investing the EA process, both under the current theoretical approach and a new innovative approach. The rewards varied according to the motivation factors of the actor. The perceived rewards also provided insight into the intention of the various actors and provided an ideal mechanism to frame the different categories of actors against the existing theoretical framework, defined as part of the literature reviewed.

The type of data and the questions asked in this section formed the basis of the data chapters four to six. Broad themes derived either from the interview guide or themes emergent from the gathered data formed the sub-sections of the data chapters. The data chapters followed the research questions, and each chapter corresponded to the research sub-question. While the data collection involved distinct data gathering and data analysis phases, the next section of data analysis was conducted, in many instances, parallel to the data collection phase. This is a grounded theory trait, where simultaneous data collection and data analysis is required to develop the key categories of the research.

3.3.4 Data gathering for generating a substantive theory

The set of data for theory building, which accounts for the data gathered in terms of the unique characteristics of a developing country in creating a practical, innovative theoretical approach to EA regulation, encompassed all the data collected from both the interviews and the document research. The Charmaz and Mitchell (2001) adapted structure would again be used to gather data concurrently with the data collection detailed in the last section. The difference here was a focus on theory building. While chapters four to six reported on the collected data categorised into broad themes, chapter seven leveraged the same data and focused solely on theory building.

The use of grounded theory in this study was adopted as the general theories of public interest and the economic theory of regulation only broadly form the theoretical basis for EA regulation. The narrow focus of this thesis in developing an innovative approach to EA regulation, in the context of a developing country, required seeing beyond the existing theory discussed in the literature that was surveyed. The approach adopted in this thesis was to start with the platform of the extant theories that apply to this study and explore practical approaches to regulation that are generated as a product of a qualitative study. These practical approaches formed the first broad themes for theory generation.

3.4 Data analysis

The interviews and document analysis form the starting point of the data gathering. The next step was the data analysis. The data analysis describes how the raw data is transformed into a meaningful representation that can be interpreted. Mouton (1996) defines analysis as "the resolution of a complex whole into its parts" (Mouton, 1996:161). This section, therefore, details how the vast amount of data that was collected from the in-person interviews and document analysis, was interpreted. Glaser (2009:1) lists four techniques of classical grounded theory that was used in this study. These are coding (open and theoretical), constant comparative analysis, theoretical sampling and theoretical saturation (Glaser, 2009:1).The difference between grounded theory and other methodologies is that grounded theory calls for simultaneous data collection and data analysis (Glaser, 1998; Charmaz, 2006). The data collected was thus analysed after each interview, to create areas of focus for further interviews.

The research design of using in-person interviews is subject to bias. Hofstee (2006) pointed out that in-person interviews and questionnaires are both excellent methods to elicit data for research, but these methods are difficult to analyse and prone to bias. To address this point, a systematic and rigorous data analysis procedure was adopted.

Qualitative data has often been criticised for having data analysis that was not explicit or open to inspection (Neuman, 2006:457). To remain clear of this pitfall, this study used a three-step systematic approach to data coding suggested by Neuman (2006). This method would involve contrasting, comparing, replicating, cataloguing and classifying the object of the study (Creswell, 2003:198). Charmaz (2006:43) similarly defines coding as "…categorizing segments of data with a short name that simultaneously summarises and accounts for each piece of data". To facilitate this process, the data from the study were classified into general themes, ideas and concepts using open coding, axial coding and selective coding. This allows the researcher to easily retrieve materials that were essential to the study (Babbie, 1994). The key objective of data analysis was to move from viewing the data as concrete elements to making analytical interpretations of that data, in order to generate a level of abstraction that allows the emergence of a nascent theory that explains the data.

3.4.1 The use of the ATLAS.Ti software to analyse data

As a consequence of the volume of data gathered during this research journey, the researcher decided to use a computer program to assist with the data gathering and data analysis. The high cost of proprietary software initially led the researcher to investigate the use of an open-source freeware program. A popular freeware program was tested with the results of the first interview. The researcher felt that the program was not intuitive enough and did not provide the range of functions that were required to sort and categorise large volumes of data. Given the importance of applying the grounded theory method in analysing data in this study, the researcher decided to invest in a commercial software program that had a proven record in grounded theory studies.

The ATLAS.Ti program is a commercial program that seemed to be popular among qualitative data analysis researchers. An impressive feature of the software was its ability to analyse qualitative data, without the time-consuming (and sometimes costly) requirement of first transcribing interview data into text format. ATLAS.Ti bypasses this step by allowing the researcher to classify audio and video data directly. It also supports textual analysis directly on-screen. The author attempted using this function of the software during the coding of the first interview, and although this was successfully achieved, the process was cumbersome and did not associate the code with a quote in text format. Notable quotations from this interview had to be manually attached to the corresponding code, making the coding process more complex than it would have been had the coding been done from an interview transcript.

For subsequent interviews, a free online text to speech transcription software called VoiceNote II was used. This process assisted in accelerating the transcription of the audio interviews, but it still required extensive editing and correction. VoiceNote II did not allow for the audio file to be loaded into the software before being transcribed into text. This meant that the sound recording had to be played into a microphone for the VoiceNote II program to conduct the transcription. Unfortunately, the quality of the recording (due to excessive background noise) led to a poor transcription of the interview. The solution that worked best was to listen to the recording via headphones, pause the recording, and then dictate the text into a microphone for the program to transcribe. The process of transcribing the entire interview was, to some extent, a duplication of the interview notes. The interview notes and interview transcripts were then combined to ensure that the interview data was faithfully captured. This method proved to be the most successful and was used for the majority of the interviews.

The most important feature of Qualitative Data Analysis (QDA) software is the ability to manage codes, given the time-consuming and often inaccurate nature of capturing data. QDA programmers claim that only a computer can guarantee completeness and accuracy of the codes derived from the data (Huber & Gürtler, 2013). It would have been challenging for the researcher to manage a large number of codes and associated data, without a QDA program.

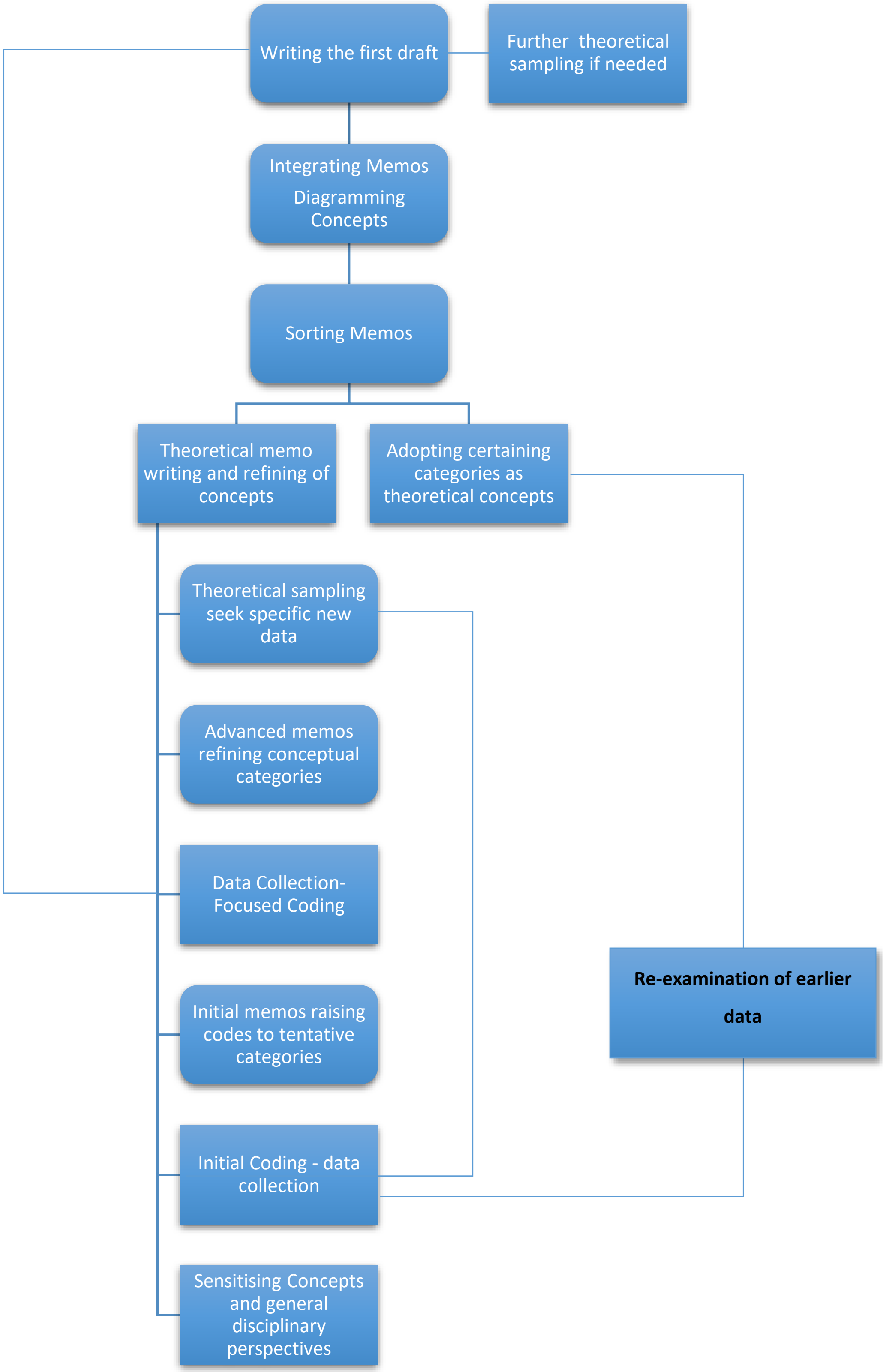
The second functionality of the QDA program that appealed to the research was the ability to create memos that relate to a data set. These memos are then tagged with the associated data segment and can be easily retrieved at a later stage. As discussed earlier, memo writing is a critical aspect of the grounded theory method of qualitative data analysis and the ability of the ATLAS.Ti program to assimilate these memos with the associated data was very useful.

Glaser (2003) does not support the use of computer-aided qualitative data analysis software as he is of the opinion that such software is helpful in describing the key categories, and does not assist in conceptualisation. While Glaser's (2003) comments are valid, it has to be balanced against the obvious value of software programs in classifying and storing large volumes of data. The ATLAS.Ti software used in this research was primarily used as a tool to manage the initial coding taken directly from the interview recordings. The subsequent processes of constant comparison, theoretical sampling and theoretical saturation was largely a manual process.

3.4.2 The approach to formulating an emergent theory for EA in developing countries

The data analysis was coded into theory using the flowchart developed by Charmaz (2006) in Figure Eight.

Figure 8: The Grounded theory process (Adapted from Charmaz, 2006)



3.4.2.1 Coding

The process in Figure Eight describes the general two-step process that is used by grounded theory. The first step is the involves naming each line or segment of data while the second phase involves a more focused selective phase that uses the most frequent initial codes to integrate and organise large amounts of data collected (Charmaz, 2006:46). The memos referred to in Figure Eight are extended notes from the data gathering process (i.e. the interviews).

Coding assists the researcher in sorting out the data and assigning a name to a particular category of data. This name is then used to compare that particular data set with other sets of data. The coding is done directly after the interview and before the next interview can take place. In this way, the coding can provide insights into areas of exploration in subsequent interviews. Coding also assists with understanding the current situation based on the data obtained. Charmaz (2006:3) describes is as understanding "…what is happening on the scene when they code the data". There are three types of coding mechanisms that were adopted. These are open coding, axial coding and selective coding. These steps may look very much like a standard qualitative analysis process, which in essence it is. Grounded theory can easily be used to complement other approaches to qualitative data analysis (Charmaz, 2006), and the approach to coding in qualitative data analysis is adapted from Neuman (2006).

The following steps were followed to analyse the interview data:

(i) Open or initial coding

Neuman (2006:461) defines open coding as "A first coding of qualitative data in which a researcher examines the data to condense them into preliminary analytic categories or codes." This mechanism was adopted to analyse the interview data. Charmaz (2006) describes the process of open coding as initial coding, in which codes are developed to fit the data recorded

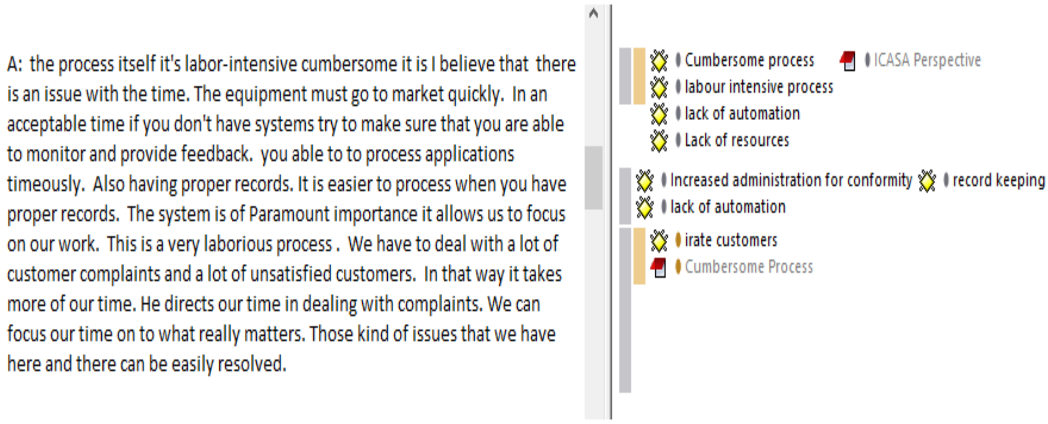
a) The recorded interviews were first recorded in electronic format (i.e. recorded as an mp3 digital audio file).

b) Interview notes were also captured during the interviews that followed the questions of the interview guide.

c) The audio file was comprehensively analysed to identify themes, keywords, central processes and key events that were present in the response. This data was captured as a text document added to the interview notes.

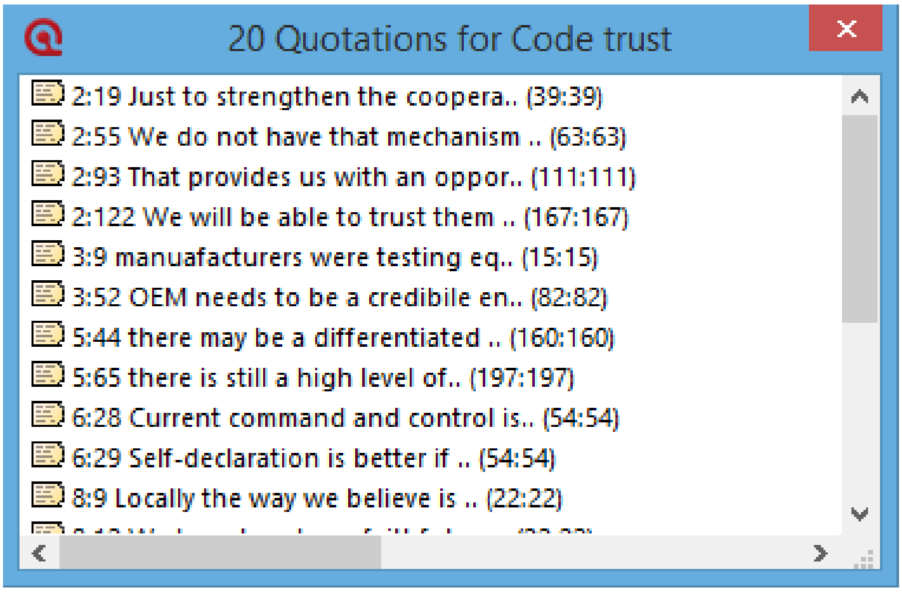
d) Initial codes were then assigned to condense the data into specific categories. The first interview's audio file was coded directly and found to be unwieldy to work with, as quotations from the informants could not be extracted. Subsequent coding was conducted using the interview note text file. All coding and data management was achieved using the Atlas Ti program. Figure Nine is an example of this process.

Figure 9: A screenshot showing the data-coding process



The mechanism used here was to appropriately name each code and highlight them using the qualitative data analysis program. This program allowed excerpts of the interview to be highlighted in the interview audio file and assigned a particular code. It also ensures that the quotation is linked to a particular code, "grounding" the code as supporting evidence. Refer to Figure 10 for an example of the quotations linked to the code "Trust" used in the study.

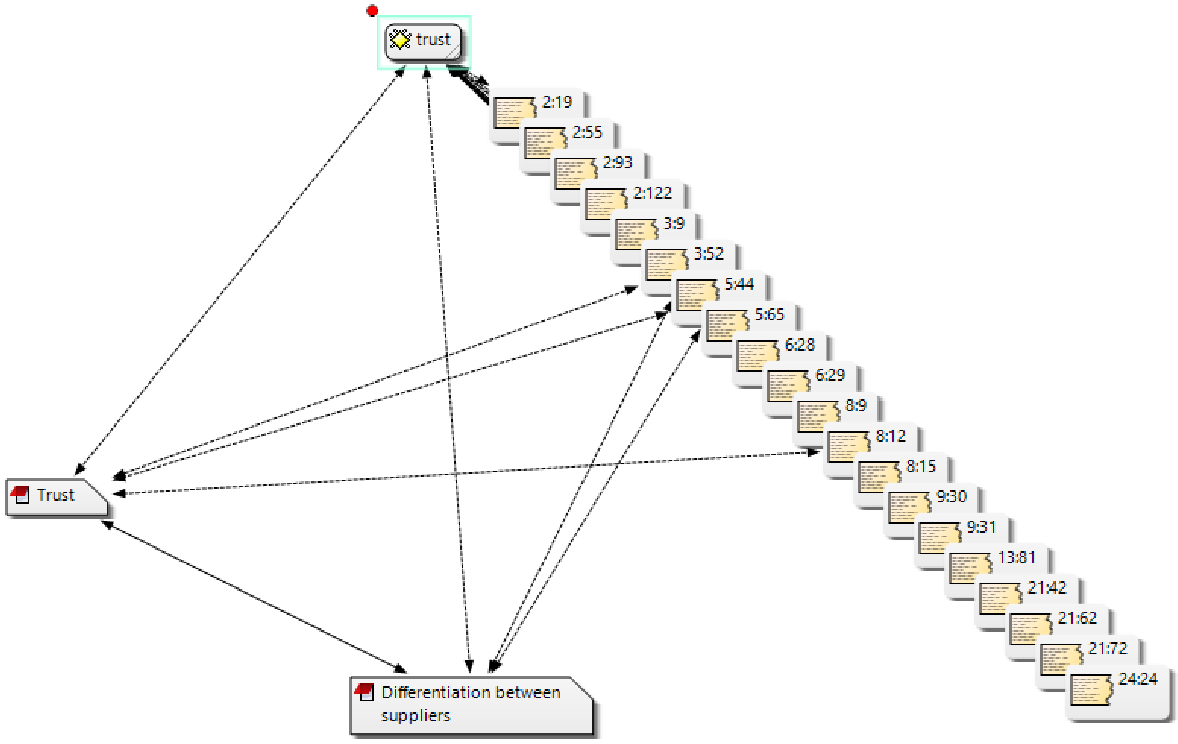
Figure 10: Quotations linked to the code "Trust."



e) Additional codes were added at any time, with the ability to change initial codes should subsequent analysis support the change. Charmaz (2006) suggests line by line coding, but this proved to be impractical, and it was the author’s view that coding by concept provided an excellent reflection of the data.

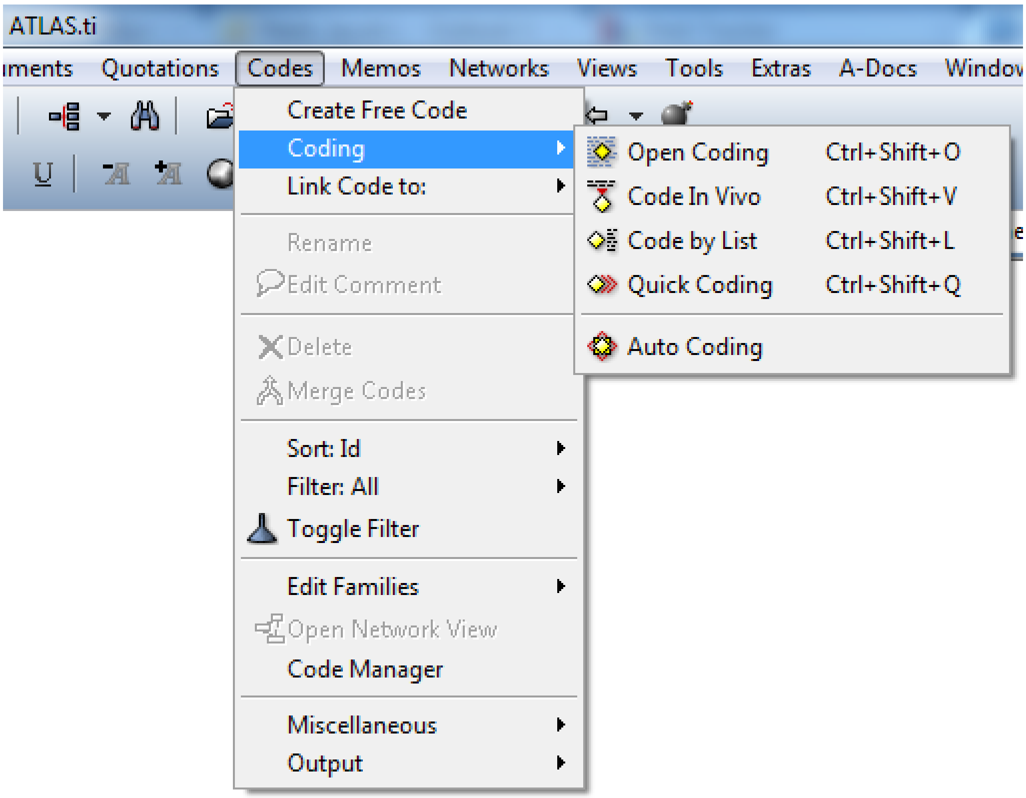
f) Codes were also linked to the memos (described in the next section) to build up the evidence to support the narrative of the memo. Figure 11 shows the same code “trust” discussed earlier, with the additional linkages to the memos relating to “trust”.

Figure 11: The code "Trust" with the related memos and quotations



g) This process resulted in a significant number of codes, as each interview or document was analysed from the beginning to the end and segments of data coded appropriately. The initial interviews and document analysis resulted in a large number of unique codes that needed to be entered manually into Atlas Ti. As the code list grew, previously used codes could be selected from a drop-down list, that kept track of all the codes captured by the author for the project. This allowed for different data segments and quotations to be linked with a particular code, grounding this code in the data gathered. This process was time-consuming in the initial interviews but became easier as the list of codes became saturated, and fewer unique new codes were added. Figure 12 shows an example of the drop-down menu of Atlas.Ti. The complete list of codes can be found in Appendix F.

Figure 12: Coding drop-down menu of Atlas Ti



The author found that open coding assisted as an intermediate step to selective coding and helped in creating the broad categories and themes before the more abstract selective coding process was implemented. Open coding worked well with the grounded theory method as it assisted in the constant comparison process of linking themes from a particular set of data to themes found elsewhere during the data collection strategy.

(ii) Axial coding

The second step of data analysis involved axial coding. Neuman (2006:462) defines axial coding as "A second stage of coding of qualitative data in which a researcher organises the codes, links them, and discovers key analytic categories". The following steps were followed to analyse the interview data further to develop code families, which are the key analytical categories (These steps are adapted from Neuman, 2006:461):

a) All themes, keywords, central processes and key events that were identified in the initial open coding was listed.

b) The initial codes were then reviewed and examined, focusing on the identification of code families.
c) Code families were developed by interrogating the data for causes, consequences, conditions, interactions, strategies and processes. This is the most important process in this stage as it stimulates thinking about linkages between concepts and themes.
d) Code families developed here were strengthened by citing multiple instances of empirical evidence.

(iii) Selective coding

The final step in this process is selective coding. Neuman (2006:464) defines selective coding as “A last stage in coding qualitative data in which a researcher examines previous codes to identify and select data that will support the conceptual coding categories that were developed”. Selective coding is not dissimilar to focused coding as the aim is to develop a higher level of abstraction from the data source. Charmaz (2006) refers to selective coding as focused coding. These focused codes are raised to conceptual categories, called key categories, through the process of memo writing, which is discussed later in greater detail. Glaser and Strauss (1967:37) define the term “category” as a conceptual element in theory.

The code families and codes that were identified from the data in steps one and two are scanned. The objective was to selectively identify cases that illustrate key categories. Comparisons and contrasts were then be made, generalising around several categories.

The coding process shown in steps (i) – (iii), ensured a data analysis process that was rigorous, well-defined and open to inspection.

3.4.2.2 Constant comparison

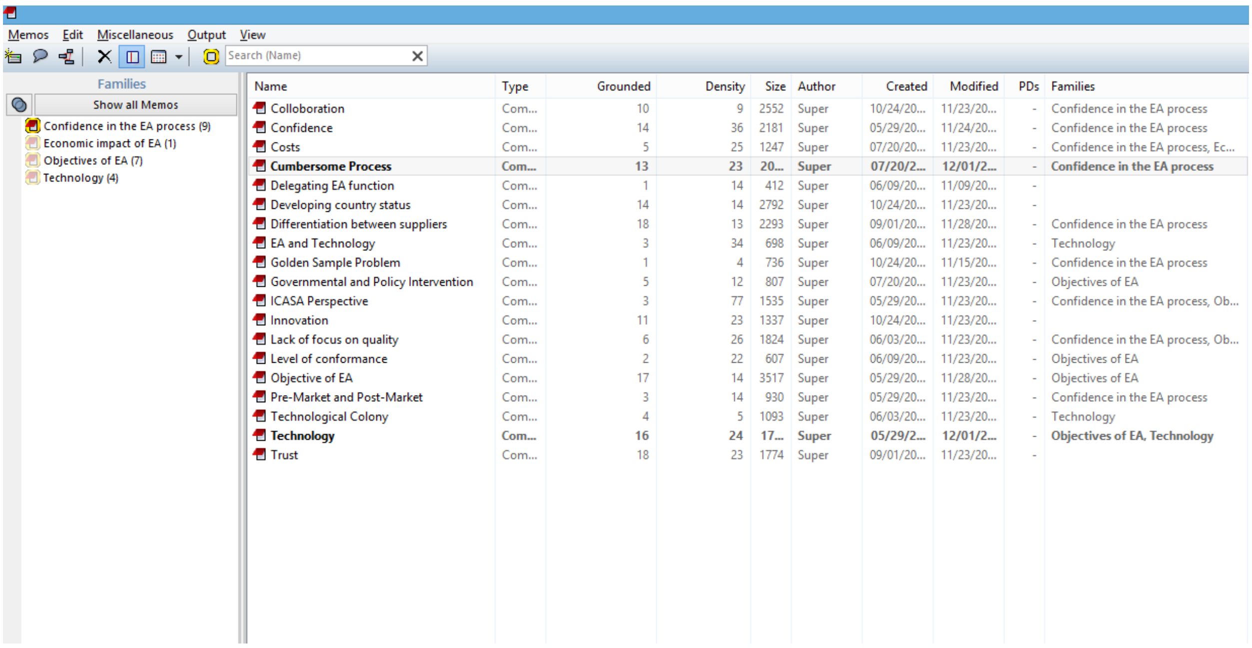
The next technique of data analysis (after coding) of grounded theory would involve constant comparison (Glaser, 2009:1). The constant comparison technique involves finding differences and similarities in the data to establish analytical distinctions (Glaser & Strauss, 1967). In the study, this was achieved by analysing the data from interviews in a particular category (i.e. equipment manufacturers) and then revisiting that data before conducting another interview in that category.

Memos are required for constant comparison and are the primary analytical notes that were written about the codes and comparisons developed in the previous stage. The author developed memos to reflect on key analytical categories that emerged from the data. Charmaz (2006:72) describes memos as:

> …the pivotal intermediate step between data collection and writing drafts of paper. Memo writing constitutes a crucial method in grounded theory because it prompts you to analyse your data and codes early in the research process.

Memos were used in the research to highlight specific categories of data to facilitate the process of abstraction. This enhances and forms a better analytical understanding of the data. Nineteen memos (see Figure 13) were written after the initial data from all interviews and document research was captured. Constant comparison with other memos and were made, and it is at this stage that tentative analytical categories were formed. Using the Atlas Ti tool, the codes that supported the memo, as well as the associated quotations from the data, were linked to the memo.

Figure 13: List of initial memos



Name	Type	Grounded	Density	Size	Author	Created	Modified	PDs	Families
Colloboration	Com...	10	9	2552	Super	10/24/20...	11/23/20...	-	Confidence in the EA process
Confidence	Com...	14	36	2181	Super	05/29/20...	11/24/20...	-	Confidence in the EA process
Costs	Com...	5	25	1247	Super	07/20/20...	11/23/20...	-	Confidence in the EA process, Ec...
Cumbersome Process	**Com...**	**13**	**23**	**20...**	**Super**	**07/20/2...**	**12/01/2...**	-	**Confidence in the EA process**
Delegating EA function	Com...	1	14	412	Super	06/09/20...	11/09/20...	-	
Developing country status	Com...	14	14	2792	Super	10/24/20...	11/23/20...	-	
Differentiation between suppliers	Com...	18	13	2293	Super	09/01/20...	11/28/20...	-	Confidence in the EA process
EA and Technology	Com...	3	34	698	Super	06/09/20...	11/23/20...	-	Technology
Golden Sample Problem	Com...	1	4	736	Super	10/24/20...	11/15/20...	-	Confidence in the EA process
Governmental and Policy Intervention	Com...	5	12	807	Super	07/20/20...	11/23/20...	-	Objectives of EA
ICASA Perspective	Com...	3	77	1535	Super	05/29/20...	11/23/20...	-	Confidence in the EA process, Ob...
Innovation	Com...	11	23	1337	Super	10/24/20...	11/23/20...	-	
Lack of focus on quality	Com...	6	26	1824	Super	06/03/20...	11/23/20...	-	Confidence in the EA process, Ob...
Level of conformance	Com...	2	22	607	Super	06/09/20...	11/23/20...	-	Objectives of EA
Objective of EA	Com...	17	14	3517	Super	05/29/20...	11/28/20...	-	Objectives of EA
Pre-Market and Post-Market	Com...	3	14	930	Super	05/29/20...	11/23/20...	-	Confidence in the EA process
Technological Colony	Com...	4	5	1093	Super	06/03/20...	11/23/20...	-	Technology
Technology	**Com...**	**16**	**24**	**17...**	**Super**	**05/29/2...**	**12/01/2...**	-	**Objectives of EA, Technology**
Trust	Com...	18	23	1774	Super	09/01/20...	11/23/20...	-	

Not all memos that were written for the research were presented formally. Charmaz (2006) describes memo writing as a personal exercise that allows one to free write ideas and categories. Memos are not necessarily the first and only construction of the categories gleaned from the data. It was an iterative process and sometimes took several revisits before tentative ideas coalesced into firm categories. These initial memos were only used to capture the initial thoughts and direction of the data and were for the researcher's personal use only. As such, these initial memos were not necessarily written using a high standard of academic prose. It was a rather simple and immediate take on the data at hand. This allowed the researcher to freely explore ideas (including conjecture) around the emerging categories, without being overly concerned with refining the raw data. Further advanced memos were then developed by interrogating these initial memos by (These steps are adapted from Charmaz, 2006:82):

i) Defining each code or category by its analytical properties
ii) Spelling out and detailing processed subsumed by the codes or categories
iii) Making comparisons between data and data, data and codes, codes and codes, codes and categories, categories and categories.
iv) Bringing raw data into the memo.
v) Providing sufficient empirical evidence to support definitions of the category and analytic claims about it.
vi) Offering conjecture to check in the field settings(s).
vii) Identifying gaps in the analysis.
viii) Interrogating a code or category by asking questions of it.

Successive levels of analysis enabled these categories to coalesce and become more theoretical as levels of abstraction are built directly from the data. The work "…culminates in a grounded theory, or an abstract theoretical understanding of the studied experience" (Charmaz, 2006:4).

The final grounded theory technique used was theoretical sampling and saturation. "Theoretical sampling means seeking pertinent data to develop your emerging theory" (Charmaz, 2006:96).

Theoretical sampling was used to develop an emergent theory from the data, code-families and key categories gathered through the research process. It involved strategically and systematically analysing and refining the key categories developed during the study, but it also assisted in defining the direction required to collect further data to saturate the categories that were developed. This entailed re-coding certain interviews to gather data to support the nascent theoretical categories that were developed. This back and forth process kept the researcher from becoming stuck in unfocused analysis (Glaser & Strauss, 1967) and was instrumental in taking the research process forward.

The theoretical sampling process also again interrogated data collected from the document analysis to refine and support key categories in the emerging theory until no new categories emerged. This is known as saturating the theory in grounded theory. Glaser's (2009) perspective on theoretical saturation highlights the pitfalls of a simplistic reading of this process when he states that theoretical sampling is not just seeing the same pattern repeating itself, but rather conceptualising the comparisons of incidents which yield new properties until no new properties emerge.

At the end of the theoretical sampling and saturation process, a substantive theory on EA regulation in a developing country emerged.

3.5 Developments in grounded theory

A brief discussion earlier in this research alluded to the fact that grounded theory has consistently been developing. This development has resulted in somewhat different approaches to the application of grounded theory from both Glaser and Strauss (1967), who co-authored the seminal work in this field – the 1967 book, *The Discovery of Grounded Theory*.

Glaser is considered to have remained closer to the original text when describing his method of data analysis, and defined grounded theory as "…a method of discovery, treated categories as emergent from the data, relied on direct and, often, narrow empiricism, and analysed a basic social process" (Charmaz, 2006:8).

Strauss, however, had reformulated his original version to explicitly explain the data analysis process, with more emphasis on verification of the data (Strauss & Corbin, 1998). Glaser (1992) completely rejects this notion, claiming that this approach contradicts the fundamental foundation of grounded theory.

The research is built upon the Straussian approach to grounded theory, as it is contemporary and assists in generating a substantive theory relevant to the environment of study. The author has found that the guidelines suggested by Strauss and Corbin (1998) were helpful, rather than being formulaic and restrictive.

3.6 Validity and reliability

The validity of a study describes "a measure that accurately reflects the concept it is intended to measure" (Babbie, 1994:143). Given the ontology was investigated through multiple realities from the perspective and experiences of the many respondents, the findings of this study would be valid. Further, two sets of data were used (document research and interviews) to further accurately represent the EA environment.

Neuman (2006) refers to measurement validity as how truthful or authentic the social reality is as described by the interviewee. To provide a valid account of social life as portrayed by the interviewee, the researcher must capture the account of the interview that is reflective of the people being studied. This is achieved in this study by recording the interviews, taking down notes and transcribing the interviews, before the data is analysed.

The reliability of a study would suggest "…that the same data would be collected each time in repeated observations of the same phenomena" (Babbie, 1994:141). As the grounded theory method was used, the findings of the study are empirically grounded, and thus repeatable. Grounded theory also follows a rigorous and well-defined research process, which also aids in repeatability.

The reliability and validity of the data are key points when measuring and analysing data during the research process. Neuman (2006:188) argued that both reliability and validity

"…are salient because constructs are often ambiguous, diffuse and not directly observable". Representative reliability is an important measure, and the measurement reliability across different social groups of interviewees involved should yield consistent results (Neuman, 2006:189). The social groups were represented by the regulator, equipment manufacturers, standards bodies and communications network operators. The response from all groups was recorded accurately and consistently, allowing the study representative reliability. Babbie (1994:141) concurs with Neuman's (2006) definition of reliability, and goes further to add that the quality of the measurement method is the important aspect that would allow for the same data to be collected each time, in repeated observations of the same phenomenon.

Mouton (1996) makes an interesting argument when he states that the affiliation of the researcher affects the responses received. He argues that an influential organisation would motivate respondents to answer questions more seriously and truthfully. He further states that respondents to an unknown organisation would react more negatively to the interview situation. This was advantageous in the study, as the researcher is a staff member of the regulatory authority in South Africa, which is a well-known organisation in the country.

Babbie's (1994) comments on reliability imply that the measurement method should be carefully considered. Neuman (2006:190) however, cites other ways in which to improve the reliability of the data. These methods do not dispute the approach suggest by Babbie (1994), but rather they complement it. Neuman's (2006:190) suggestions to improve the reliability of the data are:

i. **Clearly conceptualise the constructs:** This has been discussed as part of the measurement and analysis. The key concepts stem from the well-documented grounded theory method.
ii. **Use a precise level of measurement:** Given the constant comparison technique adopted by this research as part of the grounded theory methodology, the measurement of code-families are constantly compared to other code-families from different memos. This assists in maintaining a level of consistency in the measurement.
iii. **Use multiple indicators:** This study uses both interview and document research. These different indicators provide a level of reliability of the data.

Further, a varied range of stakeholders formed part of the interview data, thus reflecting multiple indicators.

3.7 Limitations

Hofstee (2006:116) notes that it is vital to list the most significant limitations that would affect either the reliability of the research findings. As much as the research investigates an innovative theoretical framework to EA in developing countries, the focus of the study was limited to South Africa as a study site. All interviews were conducted with respondents that are within this sector. As this was a self-funded study, the financial considerations of extending this research to additional developing countries would have been prohibitive. The unique characteristics of a developing country that apply to EA in South Africa should apply to any developing country as a whole, however, the substantive theory developed from this study is based specifically on the South African environment. Further limitations are discussed in Chapter 8.

3.8 Ethical considerations

It is the duty of the researcher to have "…a moral and professional obligation to be ethical, even when research subjects are unaware of or unconscious about ethics" (Neuman, 2006:129). The main ethical concern in this study that was the identity of the respondents. Hofstee (2006:116) looks to the researcher to identify concerns and to put into place specific procedures to mitigate that concern. As the researcher is an employee of the regulator, and the subject matter concerns the theoretical framework of regulations promulgated by the regulator, respondents needed to be able to comment without fear of reprisal from the regulator. The specific procedure that was followed to achieve this was to ensure that all names cited in the study were changed to protect the identity of the respondents. The recordings of the interviews and the identities of the interviewees was stored in password encrypted files, available only to the researcher and his supervisor. Any references to the respondent were changed to a generic and non-traceable abbreviation.

Another ethical consideration is the sensitivity of the information provided by the respondents. The interview questions solicited information about sensitive issues, such as the costs incurred in the process of obtaining equipment authorisation in South Africa. This information may be confidential to the company, and should not be divulged to third parties. The specific procedures explained in dealing with confidentiality addressed this ethical concern. Anyone reading the research would not be able to trace the individual or company that provided the information.

Another important ethical issue in social research is that of informed consent. Babbie (1994:64) defines informed consent as “A norm in which subject base their voluntary participation in research projects based on a full understanding of the possible risks involved”. The risk mitigation measures described above that was used to protect the identity of the respondents was explained to the respondents. They were also be made aware that they could withdraw from the interview at any time. These measures ensured that the researcher had the respondents informed consent at all times.

3.9 Structure of the interview guide

The types of data required for this study discussed earlier was obtained using an interview guide, that set the general parameters of the questions to be asked was also created. While Glaser (1992) and Charmaz (2006) cautions against the use of a rigid interview protocol and questions when using the grounded theory method, they also recommend planning the types of questions that will be asked. Charmaz (2006) suggests the use of an interview guide with open-ended questions, especially for novice researchers, to cover a broad range of experiences while still being narrow enough to gather the specific data required for developing a theoretical framework.

The interview guide that was adopted for the research stems from the research question and sub-questions of the study. Each area was interrogated to gather as much data as possible from the interviewee, in addition to follow-up questions that evolved as a result of the responses received. The follow-up questions were mainly directed at the particular area of expertise of the informant being interviewed, usually about an interesting point or topic that was raised as part of the informant’s response. There was thus no guide for these type of questions as they flowed from the narrative of the interview.

The initial interviews tended to follow the guide more rigidly than the subsequent interviews and these early interviews provided further areas of focus and interest to the research. Although the formal interview guide was valuable in proving suggestions on the type of data to be collected, the suggestions on other areas of research proved to be useful in facilitating rich data.

The guide in Appendix A contains overlaps in the questions, which was included purposefully to focus on certain themes on earlier threads.

This section aimed to develop a research methodology that is appropriate to the problem statement, the purpose of the research and the research questions. The method developed in this section was able to chart the way and ensure that these factors are addressed. A robust research design was used to mitigate against some of the concerns of qualitative research, ensuring the research data can be measured, analysed and interpreted. The grounded theory method suggested for this research also ensured that the research was grounded in the environment being studied, and ensured the validity of the completed research.

Chapter Four: An overview of the current theoretical approach

4.1 Introduction

The aim of this chapter is to provide data with respect to the first research sub-question of this study:

- *In which ways does the current theoretical approach to regulation pose challenges to the EA regulatory approach?*

The approach adopted in this chapter is to examine the current legal and regulatory framework through a document review while trying to ascertain the aim and objective of the framework above. This approach provides an excellent grounding by contrasting the published goals of the current EA framework with data gathered from experts in the EA field regarding the same. The first step sets the scene by identifying the key role players in the EA environment, followed by gaining an understanding of the objectives of the EA framework. Both positive and negative aspects of the current framework are researched to highlight the key challenges that the EA community face in relation to the current EA regulatory approach. Key issues such as competition, innovation, technology, quality, trade, consumer protection and standards are highlighted. Certain subsections of this chapter, predominantly those with larger volumes of data, contain figures that graphically illustrate the relationship between key concepts and themes. Although key themes of developing country effects are raised during this chapter, they are noted and further discussed in chapter five of this research.

4.2 Determining the key players in the EA environment

Nearly all commentators were of the opinion that the key player in the EA environment was the regulator. OEMs, standards bodies and test laboratories were noted of secondary importance. OZ4P provided a useful description of the standards bodies, by tiering them into international, regional and local standards. The European Telecommunications Standards Associations (ETSI), CISPR and ITU were listed as the international standards bodies, Communications Regulators' Association of Southern Africa (CRASA) and the West Africa Telecommunication Regulators Assembly (WATRA) were listed as the regional standards bodies and the SABS was listed as the local standards body. ICASA was noted to be involved with standardisation activities at every level with all agencies listed.

RN2A however, felt that the manufacturers are the most important along with importers and service providers as well. Laboratories were also important although it was notable that RN2A did not list the regulator as a key stakeholder. TLS3T included other regulatory bodies in South Africa such as the Railway Safety Regulatory and the South African Maritime Safety Association (SAMSA) as other relevant stakeholders due to their reliance on standards developed for the EA process.

Accreditation bodies, although mentioned by just three respondents, was also noted to be of importance.

4.3 The focus of EA

RM1K listed conformity with regulated standards as the key focus of EA, flowed by interoperability and efficient use of resources (such as the frequency spectrum) as other notable areas of focus of EA. While RN2A concurred that the focus of EA should be to comply with the required standards, he further added that EA should ensure that the product approved is of high quality.

Consumers were listed last as a focus area for the regulator. Harmful effects and the regulation of these effects was the next area, with special mention made to the health effects of RF radiation as regulated by the World Health Organisation (WHO) Guidelines. Safety (regarding consumer safety) was listed as "to some extent" the focus of EA.

RN2A also noted that the means of determining EA approval should be compatible with ICASA's mandate. As ICASA's mandate is derived from the ECA, all EC equipment must be subjected to EA. The Act itself, however, does not specify how this should be done and the point was raised that ICASA needs to define the mechanism to prove compliance clearly.

An interesting observation made from the data gathered from the informants was the ordering of the priorities of EA for the regulator in comparison to the network operators and suppliers. The regulator seemed to list public interest perspectives such as the safety of EC equipment *after* listing performance and interference issues. Performance, interoperability and interference issues are key issues related to the EA process, but these can be related predominantly to economic considerations. It should be noted that the regulator did not exclude the public interest objectives from the EA process, but these objectives did not seem to be the priority of the regulator.

A key focus of EA that was not being implemented by ICASA was the focus on Specific Absorption Rate (SAR). RQ7L noted that:

> Both safety and performance are important as RF equipment radiates energy. Although as SA, we have not focused on the specific absorption rate of the equipment. The health effects are paramount. Other markets have already focused on this. (RQ7L)

SAR testing measures the impact of Radio Frequency (RF) radiation on human tissue, and such testing is predominantly applicable to cellular telephones. RQ7L was of the opinion that such testing, although currently within the scope of the Department of Health, should be included as part of the EA requirements for RF devices in South Africa. RQ7L noted further that ICASA has a mandate to protect consumers, who may be unaware of the hazardous effects of RF radiation. ICASA is thus remiss in its stipulated mandate of consumer protection by not including this test as part of the EA requirements. This exclusion means that it is possible that RF equipment already approved for use in South Africa, could have detrimental effects to human health.

A final objective of the EA process, although not frequently referenced by the informants, was the importance of EA in frequency coordination. OS5J listed frequency coordination as of importance to shared frequency bands in particular, which ultimately relates to the prevention of interference.

4.4 The EA process currently operational in South Africa

RM1K noted that every manufacturer must have their equipment authorised before it can be sold in South Africa. RN2A went further to describe it as a “command and control” process in which certain documentation is required. To prove compliance, ICASA indicates which equipment and standard are required for approval. ICASA has a simplified process to control the process (especially after the equipment has been approved). ICASA did not believe that a self-declaration process would work as this may lead to inferior and sub-standard equipment. RN2A was specific that the regulator does not trust the manufacturer:

> We need the test reports due to the fact that you don't know or believe what the manufacturer tells you. (RN2A).

The general view is that the current EA process is highly inefficient, ineffective as the EA procedure is highly cumbersome (RM1K, RN2A, RG5N, SM1E, SD2M, OR1A, OB2G, OK3H). Labour intensive was another way that the current process was described. The EC market was seen as a dynamic industry with new features and new technology coming to market at a very quick rate. The current processing time has increased from 15 days to 30 days over the past few years, and this has been attributed directly to the growing volume of applications received. (RM1K, RG5N). Technology is constantly changing, and any delays cause unnecessary burden and unnecessary costs to the equipment supplier.

Technology itself has negatively impacted the EA processing time. As the number of different technologies increases on a single EC device, a verification of these technologies is required as part of the EA process (RG5N). This verification increases the time taken to process an EA application as RF engineers at the regulator would have to evaluate each additional test report technically. The human resource capacity within the regulator has not increased, although the workload per staff member dealing with EA authorisation has.

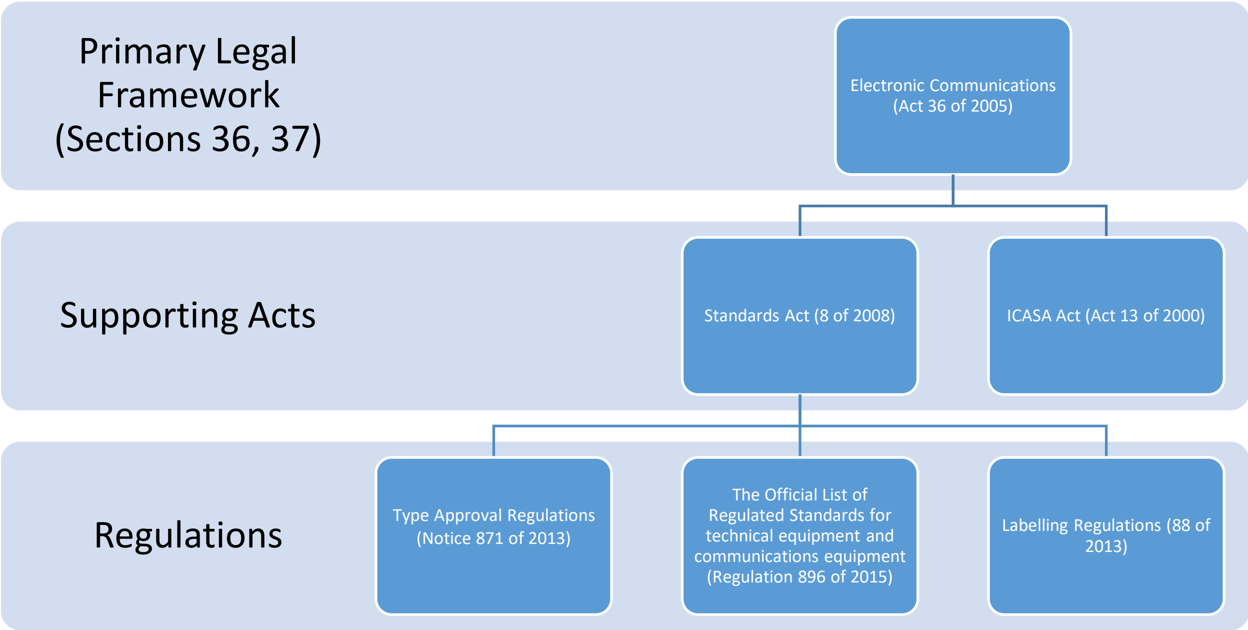
RN2A was of the opinion that a new software system is required to ensure quicker turnaround times as he felt that the global objective of EA was moving to faster processing times. This would involve processing applications timeously, maintaining proper records, enabling easier access to applications and the ability to track the application process. The overall consensus was that some system is of paramount importance to manage the EA approval process as it is a laborious process.

The shortfalls inherent with the current EA process has inevitably led to a number of unsatisfied customers and increasing complaints. These shortfalls seem to have compounded the problem of the processing time, as dealing with complaints in itself takes time. ICASA staff appear to be certain that a software system would be able to resolve this problem (RN2A, RS3R, RG5N).

4.5 Examining the EA legislative framework in South Africa

There are several legislative imperatives which govern the EA framework. The framework is made up of various Acts and Regulations (see Figure 14). These legislative imperatives, such as sector-specific Acts are sometimes broad in scope as they pertain to a wide range of regulatory measures. The data collected in this section examines only those clauses that apply to the EA environment, either directly or indirectly. For regulations unique to the EA process, the entire text is discussed. The approach followed in this section is to list the actual text applicable to EA along with further data (predominantly from the interviews) which provides an interpretation of that particular clause.

Figure 14: EA legal framework



4.6 The Electronic Communications Act

The Electronic Communications Act (ECA) was first promulgated in 2005 (Act 36 of 2005) and amended in April 2014 (Act 1 of 2014). The analysis of the ECA is an important starting point, as it drives the regulatory approach from a high-level perspective, given the statutory mandate of the Act in providing governance of EC sector.

The primary objective of the Electronic Communications Act is to:

"…provide for the regulation of electronic communications in the Republic in the public interest" (ECA, 2015).

The Act is clear in its intention from the outset, which is to further public interest objectives through the regulation of electronic communications. The regulatory approach for all regulation in the electronic communications sphere seems to be driven by this over-arching mandate of public interest (RS3R). A study of the ECA provided key discussion points that were used to determine the direction of the interviews, in relation to the research sub-questions. The first sub-question of this research, being:

In which ways does the current theoretical approach to regulation pose challenges to the EA regulatory approach?

This research sub-question presented an opportunity to test the actor's view of the current EA approach against the stated objectives of the ECA. Regarding the grounded theory method of qualitative data analysis, initial codes should be developed to guide the area of discussion. The data gathered studying the legislative framework assisted in developing the initial codes that were used later in the analysis phase.

In all, there exists 26 individual objectives and several sub-objectives of the ECA. Each objective was analysed to determine its pertinence to the EA process and the subsequent EA regulations that were promulgated.

The following sub-objectives were deemed appropriate to EA. It should be noted that the list below is not exhaustive, given the broad scope of the sub-objectives. Only the sub-objectives relating directly to the EA process has been listed:

a) promote and facilitate the convergence of telecommunications, broadcasting, information technologies and other services contemplated in this Act;

   The important wording to note is the emphasis on convergence. Convergence of Telecommunications, Broadcasting and Information Technologies indicate a requirement for a multidisciplinary, technology-neutral EC equipment.

b) promote and facilitate the development of interoperable and interconnected electronic networks, the provision of the services contemplated in the Act and to create a technologically neutral licencing framework;

   The focus of this clause is perhaps most relevant to EA, as this paragraph emphasises interoperability and technology neutrality. Technology neutrality determines the standardisation environment of EA, as only open standards rather than proprietary standards should form the basis of EA. Interoperability is the next key driver, as EA equipment has to be interoperable across multiple networks. The Carterfone ruling discussed earlier has interoperability at its core, as it facilitated the use of third-party equipment on a national telecommunication network (Wu, 2007). The focus of this ruling was the issue of interoperability of third-party equipment on a network using a defined set of standards. This set of standards would ensure operability to that network, as long as the third party equipment conformed fully to the standard. Essentially, the ECA thus facilitates a “Carterfone” like environment in South Africa.

c) *encourage investment and innovation in the communications sector;*

   Investment and innovation were defined as key concepts of the study during the literature review of EA. The economic impact of innovation and investment has also been discussed in detail (Bauer, 2010; Rogers, 2003; Santacreu, 2015). The ECA underlines the importance of these key concepts by listing them as individual objectives. The link between EA and investment as well as EA and innovation has also been discussed earlier. The concepts of investment and innovation were therefore included as part of the interview protocol.

d) *ensure efficient use of the radio frequency spectrum;*

   This objective applies to the setting of technical standards. Radio frequency efficiency is largely dependent on radio equipment and this, in turn, is regulated through the EA process. Technical efficiency is thus an important concept and has been addressed independently from administrative efficiency.

e) *promote competition within the ICT sector;*

   Competition has been extensively discussed as part of the literature review. Questions about competition were included and were considered an important theme of the research. The ability of EA regulation to facilitate competition is the primary area that was probed.

f) *encourage research and development within the ICT sector;*

   This objective is related to the clause on innovation. Research and development support innovation, which has been identified as a key concept that was probed in the research.

g) *ensure the provision of a variety of quality electronic communications services at reasonable prices;*

   The objectives of EA include ensuring that the EC equipment being approved meets the minimum standards of quality and interoperability as defined by the regulator. This is achieved by testing EA equipment in against safety, electromagnetic compatibility and performance standards (ITU, 2012:9). The objectives of quality in terms of EC equipment is thus facilitated by EA regulations and the concept of quality was explored during the interviews.

h) *promote the interests of consumers with regard to the price, quality and the variety of electronic communications services;*

This objective relates to several initial codes that were adopted as primary areas of inquiry. The first was the concept of public interest, i.e. EA regulations that are promulgated to protect consumers. The second is the quality of EC equipment, in which the concept of quality was recorded. The third and final concept was that of competition as it relates to the variety of electronic communications services.

i) *ensure information security and network reliability;*

Information security and network reliability with regards to the EA process is once again addressed by the standards process. The performance standards required for EA ensures that network reliability, in particular, is dealt with via performance standards. Network security is an extension of performance standards and reflects a single aspect of the range of topics that can be included as performance standards. This, therefore, raises an important issue of the level of the performance standard. Setting a very high level of performance (e.g. specifying additional information security requirements for EA equipment) may result in an excellent product. There will always be an associated cost, and the level of performance needs to be balanced at optimal efficiency (Barke, 1995; Baldwin & Cave, 1999:120).

j) *promote stability in the ICT sector.*

The final objective is fairly broad and is once again pertinent to the EA regulatory approach. A credible EA framework provides stability in the EC equipment industry. A stable EC environment is linked to Foreign Direct Investment (FDI), and FDI is positively influenced by the existence of a credible regulatory framework (Kirkpatrick *et al.,* 2006:166). The interpretation of “credible” is, however, problematic and relates to the requirements of a developing country. Kirkpatrick *et al.* (2006) seem to suggest that the mere existence of a “credible” framework is sufficient to attract FDI. The area of inquiry that this objective initiated was the perception of the current EA framework in the context of providing stability in a developing country.

The Minister with a portfolio linked to the information communications technology sector is tasked with issuing policy directives in terms of Section 3 of the ECA. ICASA is responsible for issuing regulations in terms of the ECA. Section 35 and 36 of Chapter 6, in particular, relates to EA of EC equipment:

Approval of type

35. (1) No person may use, supply, sell, offer for sale or lease or hire any type of electronic communications equipment or electronic communications facility, including radio apparatus, used or to be used in connection with the provision of electronic communications, unless such equipment, electronic communications facility or radio apparatus has, subject to subsection (2), been approved by the Authority.

This clause is the overarching legal framework governing EA approval in South Africa. It is an all-encompassing clause regulating the use of all EC equipment as it refers to any equipment that would be used in connection with the provision of electronic communications. The notable exception to this is the provision for ICASA to exempt equipment in terms of sub-section (2). This section of the ECA does not provide any direction with regards to the intent of the EA framework, but rather broadly mandates the approval of equipment in general. This approach is expected given the high-level direction that the Act is intended to provide.

(2)The Authority may prescribe—

(a) the types of equipment, electronic communications facilities and radio apparatus, the use of which does not require approval where such equipment, electronic communications facilities and radio apparatus has been approved for use by the European Telecommunications Standards Associations or other competent standards body where the equipment complies with type approval standards prescribed by the Authority; and

The section of the ECA seems to be more indicative of the intention of the EA regulations. It makes provision for ICASA to exempt EC equipment that has been approved for use by ETSI or "other competent bodies". It is clear that the ECA, by virtue of this clause, tries to prevent a duplication of the approval process should the EC equipment be approved elsewhere. This clause is problematic for two reasons. The first is the reference to ETSI. ETSI "…produces globally-applicable standards for Information and Communications Technologies (ICT), including fixed, mobile, radio, converged broadcast and Internet technologies[17]”. ETSI is thus not an approval body but a standards body. ETSI would produce the standards that the EC equipment would be required to adhere to, but would not conduct any EC equipment approval itself. EC equipment approvals are generally the responsibility of the national regulatory authority. Although the clause attempts to provide an alternative mechanism to the mandated EA approval process, the decision to list ETSI as an approving authority is incorrect (SN4M).

The second reason that this clause proves to be problematic is the reference to “other competent bodies” as these agencies are not defined. Given that ETSI was defined as a competent body, subsequent reference to other such bodies renders them unable to perform the approval function for the same reason that ETSI cannot conduct EA approvals (TLS2L). This clause maintains that ICASA would be required to prescribe the necessary standards to which exempted equipment should comply with. As discussed earlier, standards bodies like ETSI would be the custodian of prescribing (and creating) the standards that EC equipment would need to comply with. ICASA’s responsibility would be to ensure that the EC equipment is mandated by regulation to meet the standards as defined by ETSI.

This apparent confusion in the roles and responsibilities of the different stakeholders involved in the EA process is an area of concern that was also included as part of the discussion during the interview process. Such a disconnect at the highest order of regulatory oversight could be considered as the starting point for any associated challenges endured by the current EA regulatory framework (RG5N). The key concept here would be the confusion around the roles and responsibilities of the key stakeholders along, along with a resulting duplication of resources.

(b) circumstances under which the use of equipment, electronic communications facilities, radio apparatus and subscriber equipment does not require approval, including uses for research and development, demonstrations of prototypes and testing.

[17] For more information, refer to the ETSI website at http://www.etsi.org/about

This clause seems to be more useful than the preceding clause in the context of being implementable. It allows ICASA the latitude to promulgate regulations that exempt categories or type of EC equipment from the EA process. The key concept in this clause would be the focus on innovation. By allowing ICASA to exempt equipment being used for research and development purposes as well as for prototyping and testing, the ECA seems to be pro-innovation (RM1K). This approach however, raises the issue of a "disconnect" between the policy objectives of the ECA and the EA regulatory environment managed by ICASA. ICASA only once exempted equipment from the EA process (RN2A) and has thus not fully enacted this provision of the ECA. The operative word of this clause is that ICASA "may" prescribe circumstances that exempt EC equipment from EA and not ICASA "shall" prescribe. That fine distinction allows ICASA a level of discretion in choosing whether to implement such a clause or not. It thus speaks to the intention of the ECA, which seems to be ambivalent on whether the EA process can be bypassed or not (OH1M). If the intention was to facilitate trade and encourage innovation unreservedly, the clause should explicitly instruct ICASA to prescribe the circumstances in which EA would not be required. It would seem that the ECA acknowledges the fact that innovation through research and development is important to the EC equipment sector, but has not done enough to facilitate it (OH1M).

Technical standards for equipment and electronic communications facilities

36. (1) The Authority may, subject to the provisions of the Standards Act, 1993 (Act No. 29 of 1993), prescribe standards for the performance and operation of any equipment or electronic communication facility, including radio apparatus.

This clause is clear in its intention of appointing ICASA as the sole custodian of EC equipment. The confluence of standards and EA is evident here, with this clause deferring to the provisions of the Standards Act of 1993[18]. The Standards Act deals primarily with the responsibilities of the SABS in relation to standards. This clause once again points to the issue of roles and responsibilities. ICASA's roles regarding standards is a regulatory one. ICASA does

[18] For more information, please visit http://www.saflii.org/za/legis/num_act/sa1993112/ This link enables the download of the entire Standards Act, although the introductory page is sufficient for discerning the objectives of the Act.

not generate standards but can enforce standards through regulation. While this clause is clear in defining ICASA's role as "prescribing" standards, the reference to the Standards Act raises the possibility of role confusion (TLS2L). SABS's role in the standardisation process is not in conflict with ICASA's role in prescribing such standards. The Standards Act was therefore added to the list of documents to be reviewed to investigate whether such role confusion existed and can be found elsewhere in this document.

(2) Any such standard must be aimed at—

(a) protecting the integrity of the electronic communications network;

(b) ensuring the proper functioning of connected equipment or electronic communications facilities;

(c) ensuring interoperability, interconnectability and harmonisation; and

(d) avoiding harmful interference with the electronic communications network.

Earlier during the review of the objectives of the ECA, the public interest perspective was clearly visible. This point of view is not included in this section of the ECA. This section deals exclusively with the performance aspects of EA. EA approval consists of three key categories, being performance, safety and electromagnetic compatibility (ITU, 2012:9). The aims listed in this clause are only applicable to performance and electromagnetic compatibility. Safety standards are notable in their absence, and only the technical performance characteristics are mandated by legislation in the ECA. The public interest perspectives described earlier has not been captured through the lack of safety standards. It could be argued that the line "*proper functioning of connected equipment or electronic communications facilities"* may imply that safety standards are inherently included. This argument, however, is dubious as interoperability and electromagnetic standards are uniquely identified while safety standards are not. This data is key in determining the policy objectives of EA in South Africa.

The standards led emphasis on functionality of EA equipment raises questions on what the focus of EA regulation in a developing country should be, given that the focus in South Africa is biased towards the protection of the network and the prevention of interference (RN9B).

(3) (a) The regulations made in terms of subsection (1) may, for the purposes of this section and without publishing the text of the technical standard, incorporate any technical standard by reference to—

(i) the number, title and year of issue of the technical standard; or

(ii) other particulars by which the particular standard can be identified.

(b) Any technical standard incorporated as contemplated in paragraph (a) is considered to be a regulation to the extent that the technical standard is not contrary to the regulations.

Clause 3 allows for the technical standard to be listed through a unique naming mechanism, without the entire text of the standard being incorporated into regulation. RD8M noted that this clause raises two areas of discussion. The first is that, given the fast-moving nature of the EC equipment environment, standards are continually being updated to reflect changes in technology. By allowing only a reference to a standard, this clause thus allows regulations to be changed much more easily by amending the title of the standard in the regulation, rather than amending the entire text. The second area of discussion revolves around incorporating standards into text. Although this clause substantially simplifies the regulation of standards, it still incorporates the use of standards into regulation. The important question raised here is the appropriateness of embedding standards into legal documents, given the aforementioned pace of change of this environment (RD3MA).

(c) Whenever any technical standard is, at any time after its incorporation in terms of paragraph (a), amended or substituted by a competent national body, the regulation in terms of which such technical standard was incorporated in the regulations must, unless otherwise stated therein, be considered to refer to such technical standard as so amended or substituted, as the case may be.

(d) The Authority must keep the text of each—

(i) technical standard incorporated in the regulations in terms of paragraph (a); and

(ii) amendment or substitution of the text.

(e) The text of each incorporated technical standard must be open to inspection by the public during the normal office hours of the Authority.

(f) The Authority may, at the request of any person and on payment of such fee as may be prescribed, furnish him or her with a copy of the text

These sections of Clause 3 attempt to mitigate some of the problems that may arise as a result of changing standards. The clause seems to acknowledge the possibility of the standards prescribed by regulation being out of sync with the latest version of the said standards. The solution proposed by the ECA simply mandates that the most recent version of the standard be deemed to be the regulated one, even though the regulation may refer to an earlier version. This "catch-all" approach may prove problematic as there may be instances where the latest version of the standard is not applicable to a country (OS5J). The clause further prescribes an additional administrative workload to the ICASA, by mandating the regulator to keep a record of the difference between the text contained within the latest version of the standard with the wording contained in the version of the standard that has been mandated by regulation (RG5N). This additional function raises issues around efficiency, capacity and appropriateness of the EA regulatory framework specific to the adoption of standards (RG5N, TLS2L, OB2G). There is another element of inconsistency in section (f) of this clause as it gives ICASA the authority to charge a fee to provide a copy of the amended text. The preceding clauses of this section of the ECA made reference to standards prescribed by competent bodies as well as standards prescribed in conjunction with the Standards Act. It is thus reasonable to assume that these standards are not owned or developed by ICASA, and thus ICASA would not have the authority to sell such standards or text of such standards (RN2A).

4.7 The Standards Act

The Standards Act (Act. 8 of 2008) was primarily promulgated to guide the functions of the South African Bureau of Standards (SABS) and to promote the development of national standards for South Africa. The following clauses are of value to the EA process in South Africa.

WHEREAS it is desirable to—

• *provide for the continuation of the SABS as the peak national standardisation institution in South Africa responsible for the development, maintenance and promotion of South African National Standards;*

This clause reiterates support for the SABS as the primary institution responsible for standards in South Africa. There is be no conflict between the provisions of the ECA and the Standards Act with regards to EA, as the Standards Act is acknowledged to be the primary repository for standards and standards related functions (TLS3T).

• *ensure provision of an internationally recognised standardisation system that continue to support the needs of South African enterprises competing in a fast-paced global economy; and*

This clause provides pertinent information with regards to the objectives of the Standards Act. The first would be the provision of a standardisation system. As discussed elsewhere in this research, economies of scale brought about by standardised equipment allow for lower prices of EC equipment. TLS3T notes that the formation of a standardisation system within South Africa is a major step in this regard. The next point, being the goal of having an internationally recognised standardisation system, reflects a larger objective of aligning the South African standards environment to the international context.

The clause also recognises the fast-paced global economy, which has already been identified as a critical factor in the EA environment. The standardisation system is aimed at supporting this fast-paced global environment, although the particular focus in this clause alludes to the world economy and seems to be centred on a commercial focus.

• *promote South African National Standards as a means to facilitate international trade and enhancing South Africa's economic performance and transformation,*

The clause above builds upon the focus on international recognition with the aim of facilitating trade and enhancing economic performance and transformation. Trade is thus an important concept and was included as part of the initial area of exploration during the interview process. The overall focus of this clause is an economic one, with standards serving as a basis to facilitate trade and investment to support economic growth.

Incorporation of South African National Standards in laws

28. (1) A South African National Standard, or any provision thereof, that has been published in terms of this Act in respect of any commodity, product or service which may affect public safety, health, or environmental protection, may be incorporated in any law.

(2) The South African National Standard, or any provision thereof, contemplated in 35 subsection (1) may be incorporated by referring to—

(a) the title and the number; or

(b) the title, the number and the year or edition number.

The ECA is consistent with the Standards Act in terms of incorporating standards into law. The ECA prescribes the process described in section 28(2)(b), with the provision of referring to the latest version of the standard should the standard be updated. The focus of this clause seems to be around standards that affect public health and safety or environmental protection. The assumption which appears to be made here is that only these types of standards would be incorporated into legal documents such as regulations.

4.8 The type approval regulations

The Type Approval Regulations (Notice 871 of 2013) was primarily promulgated to streamline the type approval process in terms of the ICASA Act as well as to specify a new fee framework with respect to type approval applications (RM1K).

RN2A considered Section 2(3) of the type approval regulation as the most interesting since it specifies the distinctly the purpose of the type approval regulations as:

"Protect the integrity of public networks, the consumer and to avoid harmful interference."

The public interest perspective of consumer protection is listed for the first time in a regulatory document. The ICASA Act did not contain any references to consumer protection, only to network protection.

Section (4): Supplier registration

The regulation calls for all suppliers of telecommunications equipment to be registered by ICASA. There is no cost for this registration.

Section (6): Simplified Type Approval procedure

RN9B considers section 6 of the type-approval regulation as a critical one as it deviates from the principle of insistence on type approval for every product per supplier. Section (3) of the regulation states that:

(1) Any Equipment used or to be used in connection with the provision of electronic communications, unless explicitly exempted by the Authority, is subject to Type Approval by the Authority.

(2) All Equipment for which a valid ICASA Type Approval Certificate was issued prior to the promulgation of these Regulations will remain valid pursuant to these Regulations.

A strict interpretation of this section would mean that even if the equipment has been approved by ICASA by a particular supplier, any subsequent providers of that equipment would still need to apply for their own approval.

The previous section dealt with the registration of suppliers. The type approval certification thus issued to the supplier and not based on the equipment. Section (6) of the regulation attempts to remedy this duplication of the type approval process by providing an alternative approval route. This section states that:

(1) A Supplier may request that Equipment that appears on the Authority's Type Approval Register be subject to a Simplified Type Approval process.

(2) The Supplier must ensure that the Equipment applied for is identical to the Equipment that is already type approved and appears on the Type Approval Register.

(3) This process does not require the submission of test reports, however, a representative sample may be required;

(4) Regulation 5(3) to 5(6) shall apply with regard to Simplified Type Approval process/es.

While this clause of the regulation significantly reduces the administrative burden to the equipment supplier, it does not eliminate it entirely. The supplier, should they wish to supply equipment that has previously been approved by ICASA, would have to still apply for type approval once again. The simplification of this process relates to the removal of the requirement for test reports. The removal of the test report requirement significantly reduces the financial and administrative burden to the supplier of the equipment (SN4M, SD2M, SM1E).

Section (7): Applicable standards

(1) The Authority recognises only standards issued by a competent standardisation body.

RN2A stated that ICASA publishes a list of standards as a regulation, called “The Official List of Regulated Standards for technical equipment and communications equipment” (Regulation 896 of 2015), commonly referred to as the “Official List”. ICASA considers standards from various standards bodies such as ETSI, before mandating via regulation the standards required for type approval. Should ICASA select a standard from a competent standards authority, the only check regarding standards that ICASA would conduct during the EA process would be whether the test report submitted shows conformance to the standard.

(2) The applicable technical standards for Equipment are found in the Technical Regulations.

This technical regulation is the “Official List” described above. This clause gives regulatory effect to the technical standards. The administrative detail of the type approval process is stipulated in this regulation, while referencing the technical detail can be found in the Official List. Both the details contained in the technical regulation as well as the details listed in this administrative regulation are required to describe the type approval process in South Africa fully (RM4J).

(3) In the event where Equipment requiring Type Approval was tested to a standard which is not in the Technical Regulations, then such a standard must be technically identical to that determined by the Authority for such Equipment.

This clause gives a certain amount of leeway with regards to the standard required for type approval. By specifying the term "technically identical", this clause does not contradict the technical requirements needed for type approval. It provides for standards that may contain the text and limits of measurement of a particular standard, but not necessarily the identical name of that standard (RN6B).

Section (8): Test reports

(1) The Authority will accept only test reports that are issued by any ATL.

As previously discussed, the standards required for type approval is defined by ICASA and listed as part of Official List regulation. The requirement for test reports tested to these regulated standards is that they should be issued by an Accredited Test Laboratory (ATL). ATLs conduct testing of equipment to the prescribed standards defined by ICASA. ICASA then has to ascertain whether a test report submitted by an equipment supplier is authored by an accredited testing facility (RD8M).

(2) Applicants must submit a test report in full and are not allowed to remove or modify any portion of the

test report.

The mechanism of the submission is not clearly defined and the equipment supplier could either send a hard copy of the report or provide a digital copy of the report (RD8M). Hard copies of the reports would prove problematic going forward, given the size of a test report, storage considerations and the environmental impact of printing such as a document. In terms of administrative efficiency, soft copies of the report would be the preferred option.

(3) A test report is only valid if it was prepared for the Equipment for which approval is being applied for and if no modifications have been made to the Equipment following the completion of the test report.

This clause, although well-intentioned, is problematic for ICASA to enforce (RQ7L). The clause stipulates that the equipment being ultimately sold by the supplier should be essentially identical in all respects to the equipment that was tested for the type approval process. The obvious challenge to this clause is proving a discrepancy, should one exist.

The onus rests with ICASA to test a random sample of the retail equipment and compare it to the original test report. Such testing is expensive and would result in additional administrative costs to the EA process (RG5N).

Section (9): Provisional Type Approval

The regulations allow for a provisional type approval for test and experimental purposes:

(1) Subject to Section 35(2)(b) read with Section 32(1) of the Act, the Authority may award a Provisional Type Approval Permit, for a period of up to 6 months for the following purposes:

(a) Use of Equipment for a trial, demonstration or research purpose on a non-commercial basis; and

The clause supports innovation by permitting the use of equipment (on a non-commercial basis) for testing and research. The important point to note here is that provisional type approval does not require a test report, which supports innovation (RM1K). Prototype EC equipment would not necessarily have type approval and would require a waiver of the type approval requirements to be allowed into South Africa for testing purposes.

The quantity of equipment allowable under this clause is a notable omission from this section. Although it may prove challenging for the regulator to determine an absolute number of equipment permitted in terms of the provisional type approval, the open-ended nature of this clause makes it problematic to regulate the quantity of equipment condoned from requiring EA (OH1M). It is dubious that the time frame of six months would be sufficient to allow for an extended testing scenario, however, given the fast pace of technological change, six months may be adequate (OH1M).

(a) Testing the Equipment in an ATL in South Africa.

This clause allows for the local testing of EC equipment in South Africa, to obtain EA certification. It encourages local trade and innovation is proactive in removing technical barriers to trade (RM1K). It is, however, noteworthy that the emphasis is on an accredited test laboratory and not any test laboratory in South Africa. This clause could prove problematic in the scenario where a South African network operator tests equipment in an in-house (non-accredited) test facility for that operator's internal network testing (OB2G). Although section 9 (1)(a) can be argued to cover such an eventuality, the prescription of an accredited test facility seems superfluous.

4.9 Overall view

The EA regulations were seen as being too broad (OS5J, OH1M). Not enough emphasis was placed on allowing ICASA to exempt certain types of equipment from EA, as allowed in terms of the overall legislation - the ECA. Informants felt that there was a need to define a narrow scope for equipment that would require approval (SM1E, SD2M, OK3H, OB2G, OS5J, OH1M).

4.10 Industry and regulatory perspective regarding the objectives of EA

While the previous section dealt with the objective of EA from a legal perspective, the next section will provide a regulatory perspective based on the informants interviewed.

All respondents were unanimous in their view that EA was a vital process. RM1K stated emphatically that the core objective of EA was to ensure the integrity and Quality of Service of EC equipment being sold in the South African market. Integrity and safety were also listed as secondary objectives as well. RM1K felt that the importance of EA was primarily to give consumers confidence in the EC equipment in that it should not have any harmful effects and should be safe to use. Confidence was noted as a key theme, especially amongst the regulatory staff at ICASA. This confidence was both in the EA process itself and in the equipment approved via the EA process (RG5N, RS3R, RM1K, OS5J, RN6B, RM4J). The quality and consumer protection aspects were most often included at the end of the explanation by the informants.

RN2A listed the efficiency of spectrum utilisation, interference protection and maintenance of equipment as further objectives of EA. The rationale behind this line of thought was that EA saves network operators money by preventing network breakdowns caused by sub-standard equipment (RM5S). Their network is thus protected from harm and should ensure a high quality of Service (QoS). RM4J echoed these sentiments, by noting that without EA, there would be “chaos in the market”. EA allowed for devices to coexist in shared frequency bands, by rigorous testing to standards drafted to prevent interference. By following rules and limits determined by these criteria, a myriad of devices can operate without the risk of interference. RS3R cited an example of a license-free band that is largely dependent on EA to prevent interference. In Nigeria, the 2.4 GHz licence free band is so chaotic that new market entrants do not want to enter the market using this band, as they cannot conduct commercial operations with an appropriate level of comfort that the service would work. On the other hand, a well-regulated 5.8 GHz band (which is also a licence free shared band) works very well in South Africa due to the coordination assisted predominantly by the EA process. The band is so well managed that even high power links (which can cause widespread interference) can work in the same band with other lower power devices.

RM1K reiterated that a one-word core objective to describe the EA process would be “Integrity”. The end-user perspective must be taken into account as the consumer must believe that the product meets all the stipulated requirements when the ICASA sticker is affixed to that device. The same would apply to network operators as well.

RG5N summed up the “confidence” view on the objectives of EA by stating that:

> The main objective is to build confidence in the use of equipment. Whosoever uses the equipment must be confident that the equipment causes no harm, regarding safety and interference. (RG5N).

The ICASA EA process is meant to instil confidence to consumers who see the ICASA logo on the device. The ICASA logo affixed to any EC equipment would mean that that device has been rigorously checked by ICASA, who has applied due diligence in assessing the equipment regarding its functionality and safety (RG5N).

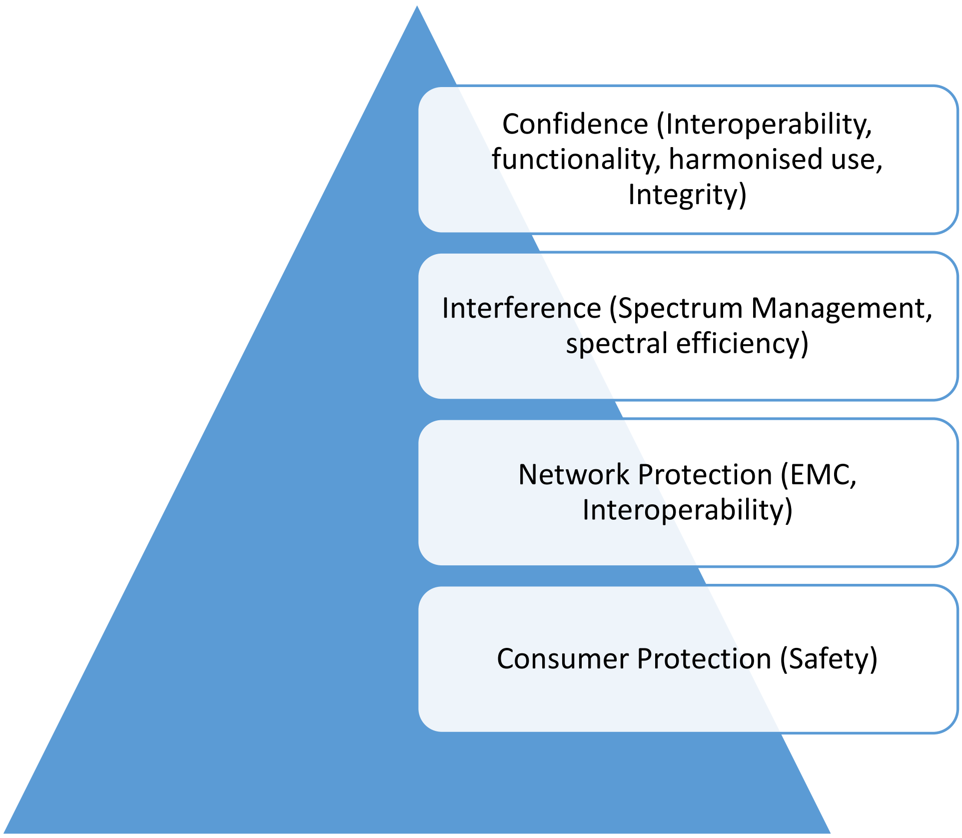
Staff that are dealing with EA approvals clearly noted that the objective of EA was conformance only to essential or functional requirements (RN6B, RQ7L, RD8M, RM4J, TLS3T). This essential requirement extended only to technical requirements of the device, i.e. the basic set of standards that certify the operation of the equipment. He (2010), discussed earlier in the literature, noted that command and control regulations are susceptible to informational deficiencies. The issue of testing and the production of test reports highlights this as a real world example, where ICASA is unable to make decisions without the information supplied to it by third parties. As much as the burden of proof within the current EA regime lies with the EA applicant, the regulator is completely reliant on external sources of information to enable it to make a decision (RN6B, RQ7L, RD8M, RM4J).

Creating a local market for equipment manufacturers was also seen as an objective of EA (RQ7L). South Africa’s reliance on imports for the supply of EC equipment was considered to be a risk. South Africa would not possess the intellectual capital associated with the imported equipment, and the overall impact on the economy would be limited when compared to locally produced EC equipment. The objective of the EA regime should thus be to:

> The intent should be to create a space for our manufacturers. The country would gain as we would develop more products for our country. We would not need to import as much. We can create exactly what we need as we would be catering solely for the SA market. (RQ7L)

Job creation, intellectual capital and support to the local economy were some of the benefits listed with promoting a local manufacturing sector. TLJ1H cautioned that in most instances where local manufacturing exists in South Africa, it is not manufacturing in the “proper” sense but rather assembly. TVs were listed as an example in which assembly of the various modules, manufactured worldwide, are assembled to form the end product. In such cases, even though the final product is manufactured in South Africa, very little to no intellectual capital would reside in the country. TLJ1H, however, conceded that the benefits of local assembly were numerous should be ultimately encouraged and supported. Figure 15 summarises the broad responses of the Objectives of EA.

Figure 15: Objectives of EA



4.11 Investigating the current EA process

RM1K felt that the current EA process achieves only 60-70 percent of the objectives of EA. There are still devices that make it onto the market without type approval. A lack of post-market surveillance prevents the confidence level from being higher. There is also an issue of a “golden sample” where the testing of one sample of EC equipment results in EA. This sample may not be representative of the entire production of that particular model of equipment. RM1K and RN2A also conceded that inefficiencies in post-market surveillance also contributed to the low confidence in the EA process.

Confidence is thus a recurring theme in the data gathered in all sections of this research. The issue of confidence will be discussed in terms of confidence in the EA process itself, confidence in the testing facilities, confidence in the test reporting and confidence in the post-monitoring abilities of the current EA regime. The issue of confidence thus raises serious concerns about the efficacy of the current EA process in terms of achieving its stated objectives.

The biggest single drawback that was listed by the majority of informants was ICASA's inability to confirm the validity of a test report, through an independent verification mechanism such as retesting the product. Test laboratories in South Africa do not have either the skill or equipment to test the majority of international standards that are regulated in South Africa (OB2G). The problem compounds if the equipment is tested at an internal accredited lab, as the equipment supplier is essentially attesting to the validity of their product.

ICASA has low confidence in this process, but has no option but to accept these reports, given that they are from so-call "accredited" laboratories. The concept of accredited laboratories is thus proving troublesome to ICASA's equipment authorisation efforts (RN6B).

RN2A & RM1K suggest bi-lateral cooperation required with International test laboratories to improve the levels of trust and confidence. Trust in the process is thus a common theme. Even if ICASA is not satisfied with the test documentation, they do not have the grounds to decline an application if people follow the rules. This is a challenge for ICASA as they have stated that it is not feasible for them to build their own test facilities. Some solutions suggested for this problem include the use of current facilities that exist in the country and to consolidate these facilities to upskill them to be able to perform the necessary testing. The second solution involves collaboration with test facilities external to the country.

PP1L recounted an example that illustrates the sub-optimal utilisation of existing test facilities, where the then Department of Communications (DoC) provided 30 million rands in funding to the SABS for them to establish a regional conformance testing facility. The staff at the SABS were trained internationally to gain the requisite skills required to operate this test facility. The objective of the DoC was for SABS to operate this facility as a commercial venture by expanding into SADC countries. The failure of SABS to broaden the reach of this facility resulted in the laboratory ceasing operations after just a few years of existence. The political goal of reducing the cost to communicate was not achieved and the cost of testing remains high. The facility was recently afforded a second opportunity to become commercially viable, as the current Digital Terrestrial Television (DTT) process requires EA approval for the set-top boxes. SABS was able to repurpose this facility to test these set-top boxes, but the cost of testing is still high, and the DoC views this initiative as a failure. The aim of government was to reduce the costs to communicate in South Africa, and the high testing costs are contrary to their objective.

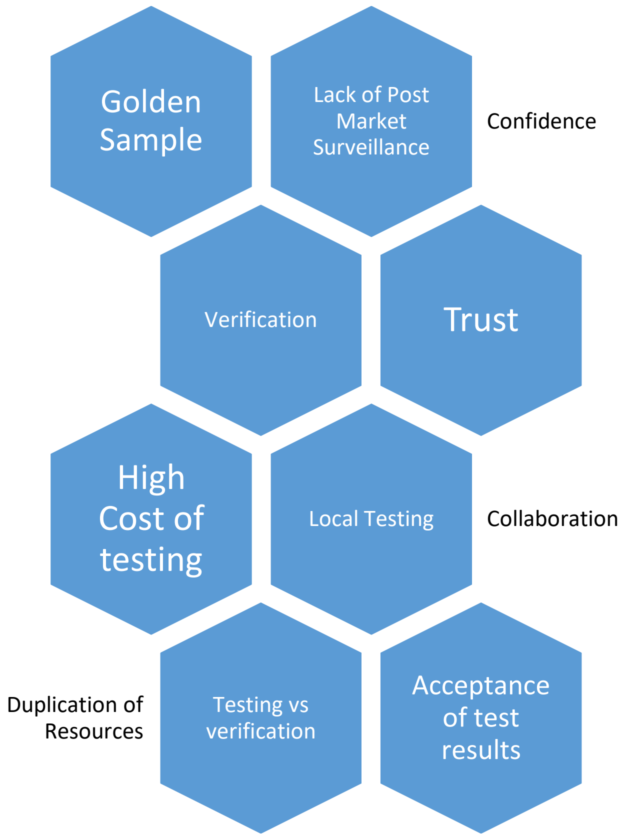
Industry experts, however, believe that the requirements for testing in itself is an exercise in duplication, which is a significant contributor to the problems associated with the EA process. OB2G noted that the EA process at ICASA is not a testing process but a verification process. Verifying equipment already tested internationally was thus a duplication of effort and a waste of time and resources. OH1M stated that:

> There is no need to submit the actual test reports as a significant percentage of devices approved in Europe for example, have already been scrutinised to determine their alignment to the relevant standards. Requesting the actual test reports essentially duplicates this process – which further adds to the delays in [the] type approval process. All that time and effort to get hold of a test report to prove compliance that has already been established – it does not make sense and is a wasteful and expensive exercise. Does ICASA really deny approval equipment already show to comply with standards ? – that will be interesting to determine! (OH1M).

Radio Frequency specialists employed at ICASA involved in the technical evaluation of EA approval disagree with this assessment and note two ways in which additional checks are conducted. They state that ICASA conducts an assessment of the test facility issuing a test report, to determine its authenticity (RN6B, RM4J). This process lends credibility and confidence in the test results obtained from the test facility as well as confidence that the tested product conforms to the requisite standards required for the EA process. The second check involves a technical evaluation of the test report, checking the actual test parameters in a standard needed for EA approval to the measured result. Only if the device under test passes all technical requirements as stipulated in the standard, will the radio frequency specialist consider the equipment for EA approval.

SD2M stated in no uncertain terms that the objective of EA should be based on a business case and not a "government case". EA should support the sale of EA equipment, given the fast-moving pace of technology. Technology has commoditised the EC equipment market, and thus the life cycle of EC equipment can be very short. Delays in the EA process can render an entire model range obsolete and thus the business case objectives of ensuring quicker times to market are of utmost importance. Figure 16 provides a diagrammatic representation of the key themes.

Figure 16: Key themes



4.12 Exploring the positive aspects of the current EA process

The general opinion of the current process was the fact that a working EA regime exists in the first place, is grounds enough to consider it a positive attribute, irrespective of the flaws that exist (OR1A, RN2A, RM1K). ICASA has control and a reasonable level of confidence and control of devices that enter the country and has applied the applicable standards to these devices. The current EA regime has also kept the market vibrant.

Operators were more specific, agreeing that the EA process instils confidence that the equipment conforms to the *minimum* mandatory standards required by the EA approval process (OS5J, OB2G).

RM1K felt that the current regime is mostly in line with international regimes, but conceded that the SA EA regime is too rigid in comparison to international first world regimes. ICASA is conducting a benchmark study currently to compare the SA EA regime to international best practice, although it may be several months until that information is available. The focus of this study would be looking into exempting devices from equipment authorisation. Other developed markets have a less rigid self-declaration EA regime that is based on the trust level of that country. Self-declaration relates to a local manufacturing market according to RM1K, although there are not any manufacturers left in the South African market. The theme of trust was again noted here- no trust level that exists currently in the South African EA market as there is no feedback mechanism to verify international test reports.

The issue of resources available to the regulator to bring manufacturers to order, especially for international companies was also mentioned. As these businesses are based elsewhere in the world, ICASA does not have the resources to prosecute them for non-compliance. It is therefore easier to apply penalties to South African registered companies. In terms of the EA regulations, all EC equipment suppliers would have to be registered as a local entity in South Africa before EA can be granted. This was therefore seen as a positive regulatory requirement (RQ7L). The positive aspects of the current framework is sumamrised in Figure 17.

There are currently no penalties for non-conformance for self-declaration such as those found in Europe, where the penalties are very high and can hold directors of companies personally criminally liable. The lack of self-declaratory regime was thus considered a positive for the South African environment (RD8M).

Figure 17: Positive Aspects of Current Framework

Confidence — Minimum Requirements only

- Reasonable level of confidence
- Current process works
- Based on the level of trust that exists in SA
- Verification mechanism would be preferred

Framework Exists — Reasonable Aligned to International Best practice

- Current framework more appealing than a regulatory vacuum
- Too rigid
- Consider Exemptions
- Consider Self-Declaration

Local Registration — Companies can be held to account

- Easier to enforce regulations on locally registered companies

4.13 Investigating the link between EA and technology

Technology was identified as having a major impact on EA and has rendered some of the objectives of EA irrelevant. New EC devices have built-in technology that has made some of the requirements of EA moot. RM1K & OS5J listed software defined radios as a classic example of technology advancement. These software-defined radios can select an appropriate frequency of operation to prevent interference, without any external user input. The traditional type approval process could become too cumbersome and difficult to adopt as there would be too many certificates will be required to describe a single piece of equipment as technology advances.

Other commentators stated that technology due to standards development is ahead of the EA process. It is difficult to approve equipment as the standards required to approve such equipment have not yet been adopted by South Africa. The comment was made that it is almost impossible to stay abreast of the standards development process (RN2A). South Africa seems to be reactive to technology, which leads to delays in the deployment of certain technologies due to the rigid requirements of the EA process. The current EA process prescribes rules “up front”, so it makes the EA process difficult for new technology if such rules have not been defined.

TLS2L also added that the standardisation process in South Africa itself is much too long and listed the example of an international safety standard that was published six years ago which has yet to be adopted by South Africa. TLS2L attributes this delay predominantly to South Africa’s lack of active participation in the international standardisation arena. Had South Africa contributed to the development of the safety standard in question, there would not have been a need to adapt the standard for local adoption. The process that had to be followed to adopt this safety standard for domestic use was the primary reason for the long delay in adoption. TLS2L remarked that this is not an issue for first world countries, as their standardisation experts are sponsored by industry and can contribute and develop EC equipment standards from the inception of such standardisation projects.

TLS2L suggested that South Africa adopt a similar Public-Private Partnerships (PPPs) to alleviate some of the funding problems faced by South African experts in attending such International standardisation fora. TLJ1H estimates that South Africa is two to three models behind Europe with regards to the adoption of technology for EC equipment. Proof of that is evident when trying to download the latest drivers for new equipment to the South African market, only to find that the equipment has been marked as being “end of life” products or even noted as being obsolete and no longer supported.

OK3H disagreed with TLJ1H and stated that South Africa has kept up with technology, despite the challenges faced with the EA process. South Africa has deployed the latest 4G cellular technologies in both the network and consumer equipment and is part of the planning for 5G technologies as well. South Africa has thus not lagged into deploying the latest technologies, with network operators investing significantly in network infrastructure, albeit with the predominant purpose of exacting higher voice and data revenues. These discussions highlight the key theme of ‘technology impacting EA’.

The pace of technology also has a market perspective, with “first mover” advantage being paramount to equipment suppliers (OZ4P). “First Mover” advantage would allow a vendor first access to a particular market and can have a significant economic impact to that vendor. The EA process largely determines this benefit and any delays in the EA process erodes the associated impact. It is thus critical to operators, and suppliers in particular, that the EA process is as efficient as possible.

EA testing has also been impacted by technology. OH1M noted that testing protocols have moved from being manual to being automated. This has significantly improved testing times as well as the volumes of tests that could be conducted within a period. Increased test volumes decrease testing costs and have made the testing cheaper in the process. The move from analogue to digital test technologies has also ensured more accurate and less expensive test equipment, which has ultimately helped decrease testing costs.

Technology has also impacted the efficiency of the EA process in South Africa. RD3M stated that the rapid pace of technology has increased the total number of products that are in the market, which in turn has increased the amount of EC equipment requiring approval. Technology is based on economies of scale, with the large volumes of products being sold with small markups. Larger suppliers are sometimes forced by manufacturers to agree to Minimum order Quantities (MoQ) for the purchase of EC equipment before they would even consider selling a product to them (SM1E).

These increased equipment quantities have placed a significant strain on the resources of the regulator, as the volume of work for EA has grown dramatically. This volume has not had a corresponding adjustment in terms of the resources available to manage the EA process, ultimately leading to longer lead times in the approval process. Longer lead times are detrimental to the EC market as the pace of technology means that the product lifecycle is very short (OB2G). A six month turnaround time for EA application processing was seen as far too long and damaging to the EC equipment industry.

Technology has also created new risks for EC equipment. As EC equipment has evolved, the “Internet of Things” (IoT) has meant that more devices are now connected to the web and could thus be hacked. OB2G noted that EA should ensure the cybersecurity of EC equipment such as network equipment, by making sure that no “back door” access or malicious code is inserted into the firmware of the device.

> IoT devices will grow exponentially in the next few years. This is the future area of demand and EA must cater for this requirement (OB2G).

Previously, an individual had just one device (possible just a cellular phone), in future, we would have perhaps five devices each and each they must talk to each other(cellular phone, tablet, smartwatch, fitness trackers etc.). The new EA framework must be able to accommodate this change (OK3H).

The concept of technology being commoditised was raised by the equipment suppliers (SD2M, SM1E, SN4M). The primary aim of technology as a commodity would be the ability to quickly and easily trade this commodity. This shift in consumer thinking towards technology has made it much more difficult for equipment suppliers to differentiate their products and keep abreast of the market. In their quest to capitalise on their first mover advantage by constantly updating and upgrading their equipment, equipment suppliers are extremely susceptible to delays in getting the product to market. Delays in the EA process was seen as a significant risk to the EC equipment suppliers. When compared to the worldwide EA approval time, SM1E thought that the South African EA approvals process was cripplingly long:

> Toshiba, for example, will test the device to every conceivable test that is required. They will then send it via FTP to every country that they sell in. Three weeks later, they would have approvals from all countries. ICASA approval would take 10 or more weeks. So Toshiba would not roll out the equipment worldwide until regulatory approvals for all countries was

> acquired. The ICASA approval then delayed the release of the product worldwide. Toshiba eventually decided no more new products will go to South Africa, especially since the NRCS process took six months (SM1E).

An approval process that takes longer than three months runs the risk of the product becoming obsolete. SA then risks becoming a dumping ground for obsolete equipment. The EA process thus unwittingly supports the dumping of obsolete equipment in the country (SM1E).

RS3R offered a differing interpretation on the impact of technology on EA. The EA process should be independent of technology and thus technology neutral. The EC Act stipulates that the licensing of equipment should be technology neutral and this clause would be directly applicable to EA. EA should only be a mechanism of approval, and the technology considerations should be separated from the legal framework. This approach would avoid the pitfall of regulation always falling behind technology. A depiction of the key themes of EA and technology is presented in Figure 18.

Figure 18: EA and technology

4.14 Problems with the current EA process

The overarching theme during this discussion was that EA has a major impact on the economy and as such, the cumbersome nature and inefficiencies in the EA process leads to a financial burden to the OEMs. EA is seen as an additional cost of conformity as there are additional testing required, as well as costs for submission of EA. These costs add to the initial cost of the equipment, driving up the basic cost of the equipment. OEMs would need to recover these costs by subsequently increasing the pricing of the equipment, which in turn negatively affects the consumer.

RN2A noted that it is unfortunate that problems caused by an incomplete or incorrectly approved equipment is generally only picked up after an interference complaint. ICASA does not have a proactive mechanism for continuous compliance, hence coordination with the ICASA regional offices are required to address any defective equipment. Feedback and internal coordination were thus identified as key points. The lack of facilities to verify compliance was once again mentioned). Inspections are not done at a manufacturer level, only at the retail level (TLS3T). ICASA conducts only an administrative check, not a functional check (RN6B).

OR1A noted that a major international telecommunications operator conducted EA approvals centrally in Germany, for all regions that equipment would be shipped to for use on their networks, including South Africa. This internal approval system is rigorous and entails internal as well as external testing, to ensure that only equipment of the highest standard is approved for use on its networks. The ICASA approval process is a duplication of this effort and was seen as a simple “tick box” exercise that did not add further value in proving conformity and interoperability. RM5S & IOG4P supported this view and stated that the regulatory framework for EA itself was flawed, as the current regulations limit EA to an individual or a company, not to the equipment. This was seen as a major oversight as the type approval should be based on the equipment only, not the supplier applying for it. The issue of a duplication of efforts is then further evident, as a product that has been approved to a particular supplier would require further approval for any subsequent suppliers. If this product was already approved internationally, the duplication of the approval process is therefore compounded further.

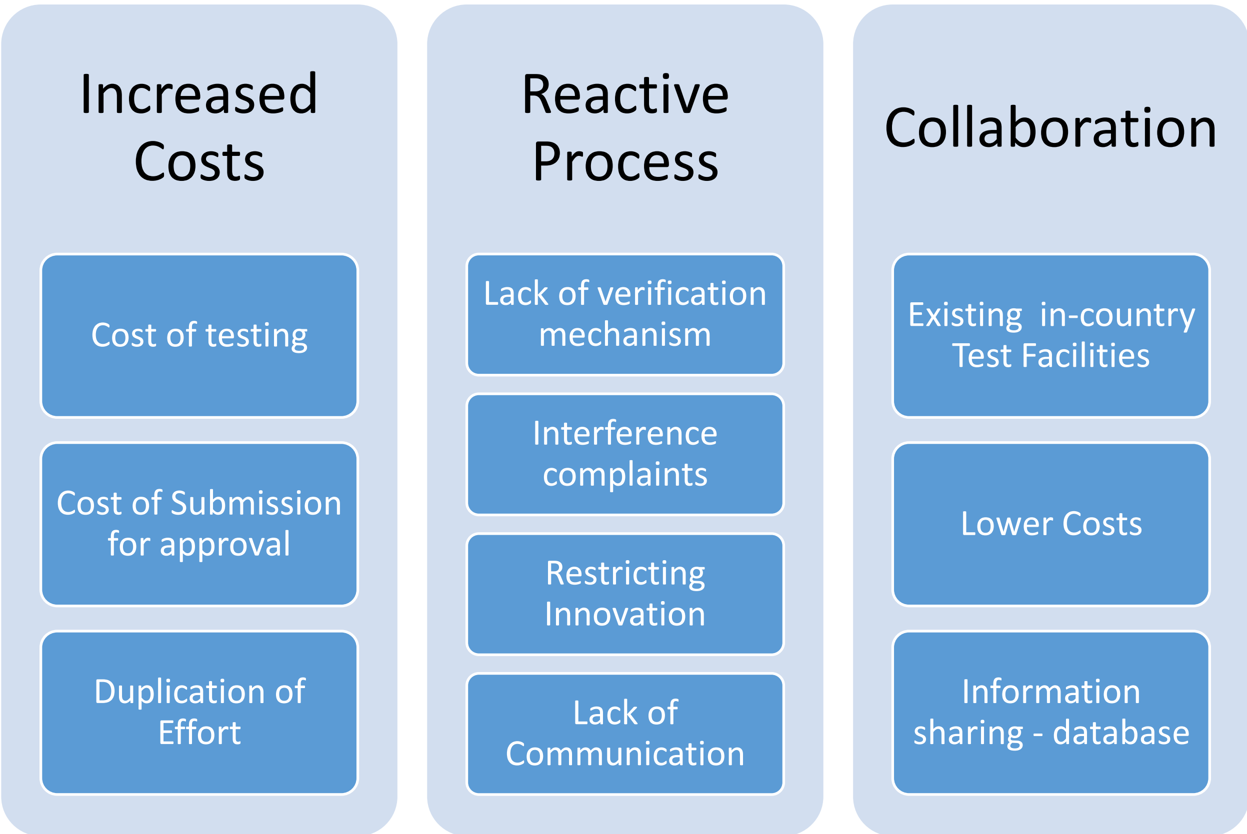
Resources required to conduct these test are not available to the regulator. Collaboration with CSIR, Innovation Hub, Houteq[19] was suggested as solutions to serve ICASA strategically to coordinate these efforts and use to its benefit. This coordination in turn should encourage local production of equipment. Local equipment however still requires international testing, which the puts the manufacturer at a disadvantage as the testing costs are too high. The net result is a restriction of innovation in the country (RN2A, RQ7L, RN6B, RD3M).

Several suppliers noted that communication or the lack thereof seems to be one of the major issues of the current EA process (SN4M, SD2M, IOW2E, OR1A, SM1E, OB2G). The EA process on its own is technically complex and demanding in terms of the requirements. A perceived lack of communication from the regulator compounds the difficulty associated with this process and makes obtaining EA approval a difficult task for suppliers. ICASA was seen to communicate infrequently with its key stakeholders in the EA process, or sometimes not to communicate at all. The ICASA website, seen by many suppliers as the first port of call for information, was considered to be a nightmare to navigate. The website was not updated regularly and did not provide sufficient detail of the EA process. There seem to be no documents available that provided an easy to use guide to the EA process. EA applicants were advised to consult various Acts and regulations, which were not user-friendly. Simple queries about the EA process meant that suppliers had to call through to ICASA, leading to long waits before they were able to talk to an ICASA staff member. ICASA staff were seen to be difficult to get hold off, with calls and emails going answered. This has resulted in a significant amount of frustration on the part of the EA applicants, further straining the relationship between the ICASA and its stakeholders. ICASA is further not active on social media, making emails and phone calls the only avenue available to EA applicants to contact the regulator. In-person meetings were thus the norm with applicants, sometimes waiting for an entire day to meet an ICASA staff member, which was a source of extreme frustration to the applicant. This frustration was compounded when the query was a simple one that could have been easily solved via email or telephone.

[19] These are testing facilities in South Africa

Information and access to information were also an issue to the regulator. TLS3T & RM5S noted that enforcement officials at the regulator required up-to-date access to EA approval information, to properly enact enforcement activities such as confiscating non-type approved equipment. The current type approval scenario made this impossible, as the EA approval databases were not consolidated and not remotely accessible. This remote access was critical when the enforcement officials went on enforcement drives to retail stores to check for illegal equipment. To further complicate matters, equipment sold via third parties and not the EA certificate holder, was an almost impossible task to trace. Figure 19 breaks down the problems associated with the current EA process into three key themes:

Figure 19: Problems with the current EA process



4.15 The “golden sample” issue

Fundamentally there was a negative sentiment around the fact that the EA process is based on a representative sample that does not reflect the actual product. This can lead to counterfeit equipment, amongst other problems. The current EA process cannot guarantee that the actual product is the same as the tested sample (RM4J, RQ7L, RN6B, RN2A, RG5N, TLS3T). ICASA does not confirm from a sample of the mass production run of the equipment that it is the same as the tested sample. No proof of compliance is required in terms of the current regulations as well. This raised the issue of trust here once again. EC equipment suppliers are not motivated to ensure that the retail equipment matches the tested sample as they are aware of the regulator's inability to test such compliance. This has emboldened some suppliers to either focus only on regulatory conformance through a “golden sample” or to submit false test reports (RN6B). These suppliers do not fear any reprisals from the regulator for such actions as the burden of proof lies with the regulator. Should ICASA develop the ability to conduct post-market verifications, the issue of trust between ICASA and the EC equipment suppliers would be addressed. The EC equipment supplier would be less likely to sell equipment that did not meet the regulatory requirements, because of sanctions that the regulator could levy due to non-conformance as a result of post-market testing. ICASA would thus be more likely to trust the information provided by such suppliers.

RM5S recalled only a single instance where ICASA had conducted post-market testing. The case revolved around a complaint from an amateur radio club about a gate motor that was radiating into the amateur radio band. ICASA removed and tested this gate motor (which was type approved), and the tests revealed it to be operating within the standards. This EMC testing was conducted at a private test laboratory in South Africa, and ICASA covered the full cost of this private testing. The complaint from the amateur radio club was thus dismissed. Collaboration with local and international test facilities was suggested as a mechanism to assist with proving compliance. OB2G & RS3R were adamant that the regulator or even the country as a whole, did not require its own test facilities as collaboration with other test facilities would be adequate to conduct post-market testing.

The simplified process EA process used in South Africa (where manufacturers provide the initial test reports which other suppliers can use for subsequent approvals) was also listed as a challenge as people do not see the need to approve a previously approved product. RN2A pointed out that a stable EC equipment market was required where manufacturers can compete and that this was still difficult to implement in South Africa.

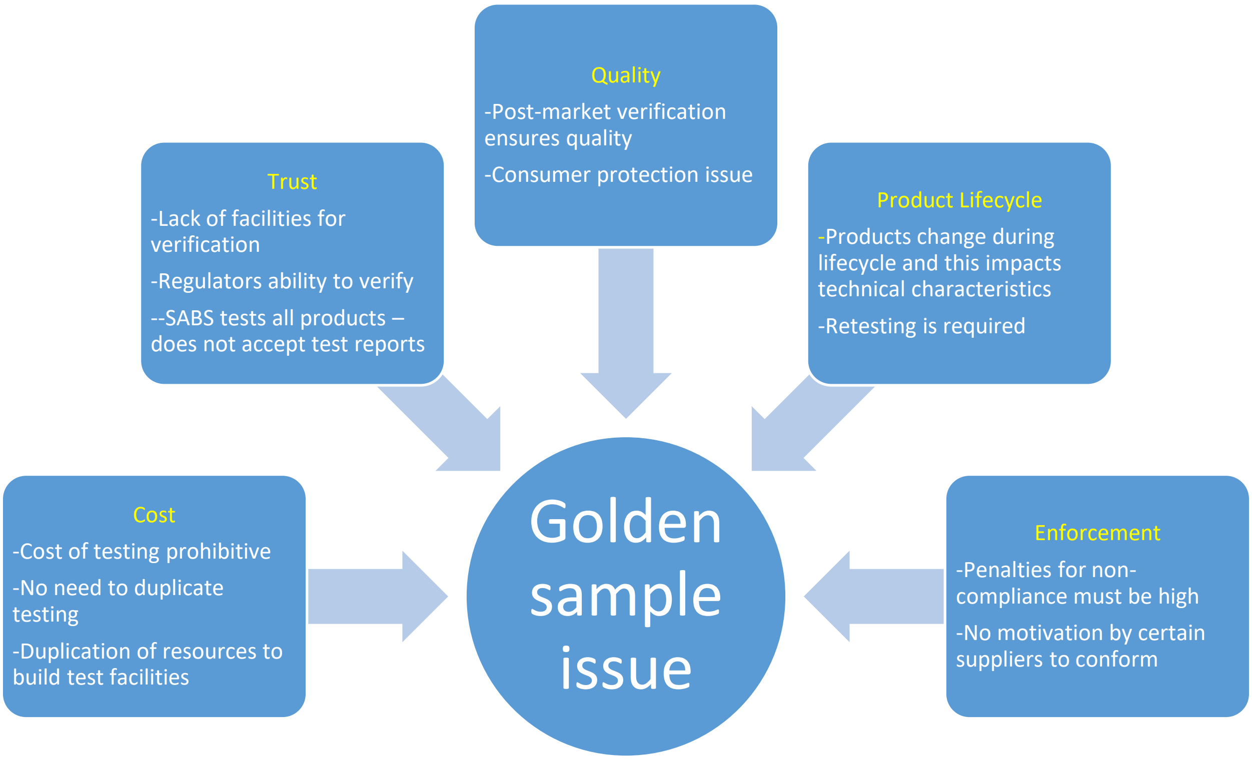
Solving the golden sample problem will have a direct impact on the quality of the product, as continuous compliance to the approved EA standards through post-market testing would ensure that the manufactured product conforms to the regulated standards. The regulated standards ensure that the equipment meets quality standards, hence the continuous testing of post-market devices will be very advantageous (OH1M).

The level of fines imposed should serve as a sufficient deterrent to suppliers should they not conform to the EA approval standards. Such fines could be used to fund future post-market surveillance and could hence be self-funding. The European Union program of post market testing was suggested as a benchmark as "…there is no need to reinvent the wheel" (OH1M). RM5S suggested an alternative funding mechanism, by suggesting that the burden of proof of compliance should be moved to the equipment supplier, thereby passing the cost of testing away from the regulator to the vendor. The penalties for non-compliance should be similar to the EU model, where criminal action can be taken against individuals such as directors of a company, should non-compliance be noted. With such harsh and stringent penalties, the likelihood of suppliers providing golden samples should be greatly reduced.

SABS have faced a similar problem and have identified the acceptance of third party test reports as a major risk (TLS2L). To that end, SABS no longer accepts third party test reports and tests all products submitted to SABS for certification. These products may include everything from toasters to motor vehicles for all their divisional clusters (electro-technical, automotive, mechanical and biochemical, mining and minerals). SABS have entered into agreements with test laboratories both local and internationally to test products that they are unable to test themselves. SABS negotiates this testing on a case by case basis and determines how much (if any) verification testing that they can do. Ultimately, the complete test report is issued only by SABS, irrespective of the where the testing was done. The supplier bears the entire cost of such testing. As SABS can randomly select the sample for testing, this approach eliminates the golden sample problem entirely. The major drawback to this process is the additional time required for testing. Equipment suppliers have expressed frustration with the "new" approach of SABS, citing significant financial loss due to the long lead times (IOW2E, SM1E, SD2M). SABS themselves concede that this approach is challenging regarding the availability of resources and advise their customers that there is a several-month-long backlog in the testing department (TLS2L).

TLJ1H noted that, even if the product submitted for testing is identical in all respects to the commercially available product, there is no guarantee that it would remain the same during its lifecycle. Most EC equipment generally face certain changes during the lifespan of that equipment, with changes in components that could impact the RF characteristics of the device. An example would be a microprocessor that may become obsolete, leading to the supplier replacing it with a newer version for subsequent production runs of that equipment. EC suppliers rarely retest the equipment or revalidate the EA approval. Such changes can have a significant impact on the emissions of the product. Even simple changes such as a firmware update can impact emissions. The same applies to software changes – a change from an Android version 1 operating system to an Android version 3 may impact issues such as battery management, which ultimately impacts the emissions from the device. These changes in emissions mean that the equipment no longer conforms to the original specification to which it received EA approval. Figure 20 depicts the golden sample issue as a summation of five key variables.

Figure 20: Golden sample issue



4.16 Understanding the cumbersome nature of the EA process

The current EA process was described as being cumbersome, flawed and arduous by several commentators (RN2A, OS5J, OK3H, OR1A, RG5N, SD2M, SM1E, IOG4P). The cumbersome nature of the process coupled with the lack of resources at the disposal of the regulator has created the general impression that ICASA is essentially a bottleneck in the entire EA ecosystem. The majority of informants agreed that a more efficient EA process was required. Quicker turnaround times were identified as a key action point to alleviate at least the bottlenecks in the actual approval process.

One of the factors that has led to suppliers becoming increasing frustrated was ICASA's response time to technical queries (SD2M). When dealing with technical reports in general, many suppliers have their principal vendors based overseas. With US vendors, in particular, any query sent to them by the South African supplier results unfailingly in a 24 hour wait period in an ideal scenario. This is owing to the time difference between South Africa and the US. The same applies to a request for reports from a factory in China, which results in another 24-hour delay. Thus even simple queries would take at least 48 hours to resolve.

> "We can have a disjointed conversion with no real response, especially when trying to explain ICASA's request to a non-English speaker" (SD2M).

SM1E highlighted a similar language barrier and stated that Chinese and Japanese manufacturers, in particular, had a difficult time understanding EA queries.

Given the difficulty in sourcing the required information required by ICASA, suppliers are aggrieved when a timely response from the regulator is not received.

Some commentators are of the opinion that in addition to the EA process being cumbersome, it is also an unnecessary duplication. RD3M notes that:

> These devices have already been approved in other countries, so why should these products be approved here again in South Africa? It is very seldom that SA will not approve a device. For RF devices, there has never been a case where a device approval has been rejected. It is a

> waste of time doing the type approval here again. The supplier should just declare that they meet the requirements and we should grant the approval.

The duplication as described by RD3M highlights a significant inefficiency of the process, as EC equipment approved for use in the EU for example, would require approval for use in South Africa. This requirement in itself does not appear unreasonable, however the fact that ICASA has seemingly never made an executive decision to disallow an EC device based on technical considerations, raises questions about the relevance and necessity of a further technical evaluation. The focus of conducting a technical evaluation is significant regarding resource allocation, as the output of six technical staff members of the regulator is channelled to a single administrative person. The issues around efficiencies discussed earlier are linked to the issues of resources and dedicating resources to a process that could be subverted was seen as inefficient (RD3M).

Other informants have been more sceptical, referring to the EA process as a "rubber-stamping" exercise with the primary aim of generating revenue for the regulator (OR1A). OB2G also noted that the EA process is "almost a rubber stamping process" and pointed out that the quality of the product is verified by the test laboratory where it is physically tested to the appropriate performance and interoperability standards. The regulator merely reviews the test reports from these laboratories without conducting any further testing. OB2G raised the question whether ICASA has ever rejected an EA approval that met all the test laboratory requirements. RD3M earlier noted not ever recalling a single instance where an RF device was rejected for approval by ICASA, after meeting all the test requirements during laboratory testing.

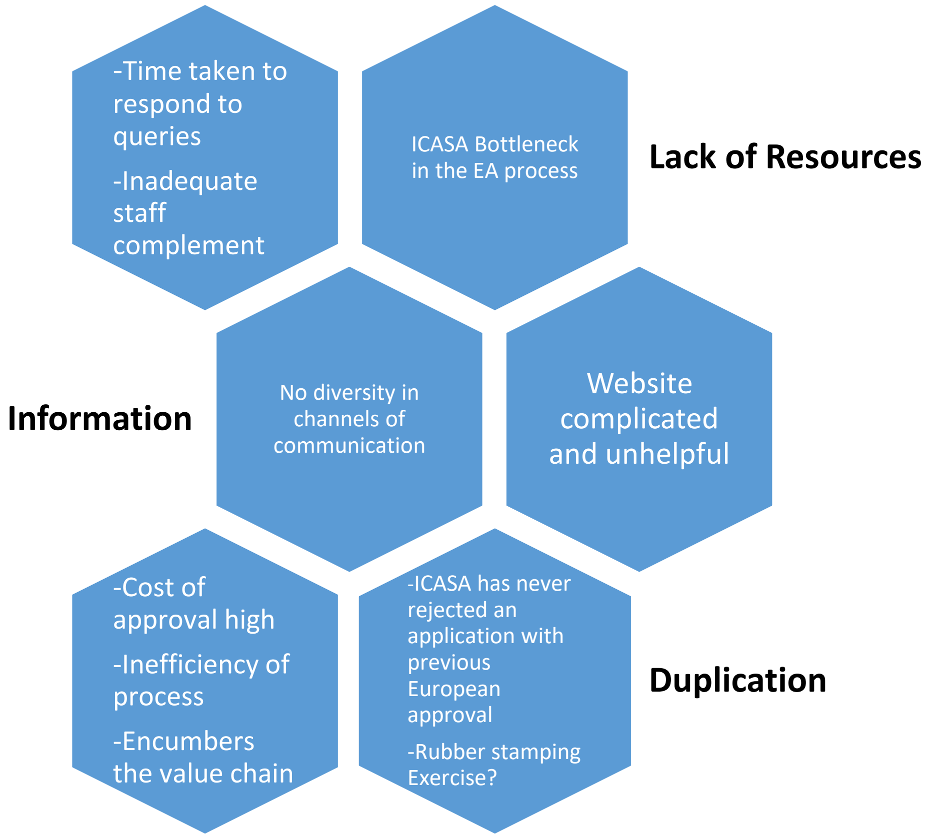
Despite evidence pointing to ICASA being the source of these bottlenecks, staff at the regulator were adamant that despite all the resource constraints, there should be no compromise with regards to fulfilling the core objectives of EA. Instead, the suggestion was to drive additional capacity to the sector. RG5N suggested a three-pronged approach to this:

Table 2: Approach to drive additional capacity to the EC sector

Approach	**Detail**
Request the South African government to help build testing capacity within South Africa.	These could be in the form of policy initiatives that must be put in place to drive a local EC equipment industry, coupled with a local test facility for the local testing of standards
Request the South African government to provide subsidies	This initiative should extend to subsidise costs, especially costs related to the testing of equipment by SMMEs.
Request National Treasury to allow ICASA to retain a portion of fees collected	ICASA is financially constrained and allowing the regulator to keep a portion of collected revenue would alleviate several resource issues.

The EA process further impacts the equipment supply market by encumbering the supply value chain. SD2M noted that the requirement to affix labels to both the product and the packaging in terms of the EA labelling regulations has at times forced EC equipment suppliers to physically open sealed equipment packing to affix the ICASA label onto the equipment. This action can invalidate the warranty offered by the international equipment manufacturer as well as adds significant labour costs. Figure 21 highlights the key issues that describe the cumbersome EA process.

Figure 21: The cumbersome EA process



4.17 Developing countries - Market for low-cost devices?

RM1K was of the opinion that there exists a market for low-cost devices in South Africa. The example of South Africa's long-term plan for driving broadband penetration was cited, as broadband penetration is largely dependent on EC equipment to access the internet. The local production of these broadband devices should be encouraged in South Africa. OK3H stated that mobile internet is the best way to access the internet in a developing country like South Africa, given the high cost of deploying fixed broadband infrastructure.

The market for low-cost devices raises another concern from certain informants around the way a developing country should handle the regulation of EC equipment performance. The consensus amongst respondents was unanimous when stating that ICASA should not compromise on applying performance standards equivalent to developed countries. The fact that South Africa is a net importer of EC equipment and a market for low-cost devices exists raises the concern that South Africa could become a dumping ground for substandard equipment (OS5J). South Africa would thus have to deploy *more* resources than a developed country to ensure that the quality of EC equipment conforms to the EA regulations.

4.18 Does the EA impact the cost of doing business?

The current EA approach is generally considered as not being able to deal with the current situation that exists in South Africa. The network operators and equipment suppliers, in particular, have raised concerns that the costs of approval ultimately impact the cost of the product (OR1A, OK2H, RG5N, SD2M & OB2G). Also of concern were the knock-on cost effects of delays caused by the EA approval process which are sometimes not easily visible. Such additional costs include storage costs for equipment waiting at Customs at the South African borders, while that supplier waits for EA. These delays, unfortunately, cause further friction between the EA applicants and the Regulator.

The EA team at ICASA agree that they are constantly "putting out fires" dealing with irate customers and do not have an opportunity to work strategically. ICASA has put in place mechanisms to monitor data relevant to EA performance at ICASA, to try to address the bottleneck caused by the EA process strategically. RM1K disclosed a long-term solution that ICASA was working on to address the informational deficiencies of the current EA regime. This solution involved a new software management system that would largely automate the EA process and would include a web-based system for ease of use. The idea of this system would be to reduce human intervention and apply algorithms make certain decisions during the EA process. RM1K stressed that the idea was not to remove human intervention completely, but rather to reduce it.

While the expenses incurred across the entire EA value chain may be high, OK3H was of the view that the cost of the EA process itself is not prohibitive. The value derived from the EA process outweighs the cost associated with the process. EA also prevents dumping of equipment (outdated EC equipment being sold at low prices) and the costs associated with such an activity is difficult to quantify, hence a cost-benefit analysis of the EA process would certainly yield a result that supports the continuation of such a regime.

Perhaps one of the biggest reasons that EA increases conformance costs can be attributed to the South African Public Switched Telephone Network (PSTN) itself (RS3R). South Africa is peculiar, in that the network impedance of the country PSTN is not the same as the rest of the world. This peculiarity means that EC equipment that is used in Europe cannot be simply employed in South Africa. It has to be tested to South African standards and technical requirements for the mere fact of the impendence being different. This impedance difference has a major impact on getting economy of scale benefits for pricing, as the devices need to be modified to match South African requirements. South Africa a very small market and has only a 1% market for EC equipment of the global market when compared to 30-40% of the world market for a developed region like Europe (RS3R).

RS3R thought that the deviation was regrettable as it causes South Africa to be unique. South Africa is, therefore, forced to adopt standards for the EA process that is not region or even country specific. This in turn drives up the cost of EC equipment as the country does not benefit from the economies of scale, had we aligned to Europe. Standards must conform to a larger market, such as Europe, as South Africa is in the same ITU region. The European Conference of Postal and Telecommunications Administrations (CEPT) is the regulatory body for Europe and contains about forty countries, which includes a vast majority of the EU market. The more South Africa can align itself to these markets, the more it can benefit from economies of scale in the marketplace. Most major EC manufacturers produce equipment for more than 60 countries and will only deviate from international standards if the market is large enough to warrant such a deviation (SM1E).

4.19 The current EA process and competition

RM1K & RM4J agreed that the current process did not impact competition negatively, but did not implicitly state that it supported competition. The current EA process treated all applicants in the same fashion and did not favour specific people or entities. OEMs were dealt with in a similar fashion to SMMEs. OK3H was aware of other EA regimes were OEMs were given a higher level of priority than other applicants but stated that this does not occur in South Africa.

RN2A, RD3M, RS3R & OH1M felt that the current EA process does support competition as it is not an exclusive process and it facilitates products from various Original Equipment Manufacturers (OEMS), which in turn drives down prices. This opens the EA process to anyone.
The inclusive nature of the current EA process was seen as a valuable and non-discriminatory by most informants. The focus of the EA process is based on technical parameters, and EA approval would be granted to any entity that can demonstrate as such. The “simplified” process extends this approach, by allowing any supplier to approve previously approved EC equipment, allowing multiple providers of the same product and thus enhancing competition.

RS3R noted that frequency coordination, made possible by EA, ensured that a multitude of devices could operate without interference within a shared frequency. This coordination ensures that any number of manufacturers can develop equipment for use in shared bands, thereby promoting competition. Without EA, only a selected number of concurrent users would be able to use a particular frequency, significantly reducing competition in the EC equipment market.

OB2G was of the view that EA should be neutral and not support or inhibit competition. EA should create a level playing field for all actors involved in the process. EA should always be transparent and non-discriminatory and treat all applicants in the same manner.

While the earlier discussion around competition centred on competition in the equipment supply market, OK3H suggested an alternative view and noted that EA was essential to promoting competition at an industry level especially with regards to number portability. Number portability allows consumers to switch from one network provider to another, without losing their number. This process may have some technical complexities, as the frequency allocation to the various cellular operators in South Africa varies, with operators using combinations of the 900MHz, 1800 MHz and 2100MHz bands for different services such as 3G, HSPA and LTE. This frequency allocation means that for a seamless and problem free port from one operator top another, the consumer handset must be able to operate faultlessly in all assigned bands for all types of services. EA is thus critical to ensure this seamless transition, with cellular operators conducting in-house testing of handsets, in conjunction with the EA process, to ensure interoperability between networks. EA is thus essential in promoting competition in the cellular market by ensuring handset conformance and compatibility to all the cellular frequency bands in use in South Africa.

4.20 The current EA process and innovation

None of the respondents would strongly support the notion that the current EA regime supported innovation. The general feeling was the opposite, that the current EA process inhibited innovation. RM1K was aware of small companies that were very innovative in South Africa but were put off by the high costs of EA compliance. The EA process was felt to be too cumbersome, and the high cost of conformity deterred innovation by cash-strapped start-up companies.

RN2A, in particular, was also of the opinion that the current EA process did not support innovation and suggested that a strong collaborative effort is required to ensure that Research and Development (R&D) technology is passed onto South African manufacturers. ICASA itself does not conduct visits to manufacturers for them to understand the entire product life-cycle. RN2A saw this as a future-looking scenario. The lack of local testing facilities was also mentioned as contributing limiting innovation in the local EA environment as local content is not encouraged since it is easier to import equipment than produce it locally.

4.21 The current EA approach and trade

The view from the regulatory staff of ICASA, in general, was that the current EA regime did support trade in South Africa, but not on a regional scale within Southern Africa. Although no intra-regional agreements exist with regards to the mutual recognition of EA in the SADC region, OH1M & OR1A were of the view that many SADC countries accepted the ICASA approval framework without further testing or certification. The current EA approach has thus unwittingly contributed to facilitating regional trade at SADC level, without any supporting governmental policy structures.

There are however regional and international imperatives to establish conformity and interoperability frameworks within developing countries intending to expand trade opportunities within ITU member countries (ITU, 2016). RG5N noted that that ITU provides this support and has also produced a guideline document for developing countries that assists developing countries in setting up their Conformance and Interoperability (C&I) test facility. ITU (2016:36) notes that:

i) Conformity assessment builds consumers' trust and confidence in tested products and consequently strengthens business environment.
ii) Interoperability results in economy benefits from business stability, scalability and cost reduction of systems, equipment and tariffs
iii) C&I increase market opportunities, encourage trade and removal of technical barriers, spreading ICT services availability and affordability
iv) ITU assists Member States in developing capacity and develop skill sets in establishing regulatory frameworks/policies on C&I

The themes of trust, confidence, trade, capacity development, skills development, affordability and cost reduction are common themes that appear in the data gathered from the informants interviewed as well as the literature reviewed. RG5N's suggests that South Africa adopt the fundamental principles of the ITU guidelines regarding the C&I framework, but adapt it to suit our requirements. The ITU (2014) framework makes the assumption that such a framework does not exist in a developing country and provides detailed guidance on how to create one. Given that South Africa already has a fairly advanced framework in place, RG5N suggests that ICASA pays specific attention to the guidance applicable to the development of mutual recognition agreements with test facilities and other regulatory authorities. Mutual recognition agreements would promote regional and international trade, reduce compliance costs, reduce time to market and reduce the regulatory burden on the regulator, without compromising on the objectives of EA.

The questions around trade raised another important issue, being the 'brand awareness' of the EA process. It seems the ICASA approval process in South Africa lacked any significant consumer awareness. It was only the larger retailers that were aware of the ICASA EA process, and ICASA receives numerous calls and emails from such retailers to verify the EA status of equipment that they stock. With that being said, RM1K felt that there exists a level of 'respect' for the ICASA sticker and ICASA brand, but this was in contrast to their reluctance to comply with another layer of “red-tape”. ICASA staff, in general, did not believe that the ICASA sticker had an adequate brand value, compliance to the ICASA EA process was driven by fear rather than an in-depth understanding of the EA process. ICASA was aware of several suppliers that still actively avoids or tries to avoid the EA process.

TLJ1H noted that the EC market was highly competitive and sensitive to escalating costs. Multinational companies like Sony have already exited the South African market, with Canon possibly following suit. High compliance costs will only serve to hasten their exit from the SA market. Suppliers leaving the EC market in turn adversely impacts competition and prices, as well as limits the foreign direct investment into South Africa. The EA process thus is not conducive to investment, given the high compliance costs and long turn-around times.

RN2A, however, held a differing view that the current EA process *does* support trade as the process does not create technical barriers to trade. Verification and testing should thus not be seen as a barrier to trade as it is a crucial means to verify conformance and trade would not be helped if the product does not function as it should.

OB2G held a differing opinion and stated that:

> “The current EA does not support nor stagnate; it is not its function or purpose. It should be agnostic. Competition and trade would happen as a consequence”.

This statement is similar to OB2G’s opinion of EA and competition, in that EA should as a consequence support trade and competition, but not have this as its focus.

4.22 The current EA approach and quality

Informants broadly supported the notion that the current EA process facilitates quality EC products. The assessment of an EA application is conducted in great detail, and the product is subjected to rigorous testing e.g. safety testing and drop testing. The fact that ICASA relies on test reports to confirm compliance, linked this section to trust as well. ICASA staff conceded that there is more emphasis on the operation of the device rather than the quality of the device. They felt that the quality of the device should be tested by the South African

Bureau of Standards (SABS). ICASA seemed to have more confidence in products certified by laboratories that they trust, although they are obliged to accept test reports from any accredited test facility.

RM1K did, however, note that the Quality of Service (QoS) as opposed to the device quality, was still a function of the EA process and managed by ICASA. This raised the issue of duplication of roles and functions.

RM4J disagreed with the assessment that the current EA process impacted on the quality of the product as ICASA lacked the mechanism to verify such a claim. As ICASA did not test products already in the market, they had to rely on complaints to gauge the impact of the EA process on the quality of equipment. Interference complaints were the most common type of complaints that the regulator dealt with, although these complaints were not necessarily an indication of the quality of the equipment as there could be a multitude of factors that impact interference. Inferior products could also simply not be reported, so the regulator did not possess an empirical method to categorically measure and report the impact of the current EA regime on the quality of the EC equipment.

4.23 Investigating the current regulatory approach to EA

All commentators unanimously described the current approach as largely command and control as ICASA controls the entire value chain of the process. There is currently no self-declaration allowed for EA.

OS5J listed an example typical to operators, where the equipment being type approved is used only by the network operator. In this case, any failure of the equipment will have significant detrimental effects on the operator's network, leading to loss of productivity and as associated financial burden. The network operator in this instance is thus sufficiently self-motivated to ensure that the EC equipment meets the required specification of the EA approval process. For cases such as this, it was suggested that the network operator is allowed to "self-declare" conformance to the EA standards, without the associated process of proving test reports as proof of compliance. In this case, the argument of conformance assessment to prove conformance would be moot, as any penalties that may be incurred by the operator for non-conformance to the regulated standards would not approach the economic and reputational damage that the operator would incur itself through non-compliance.

The larger OEMs are also acutely aware of their brand value and brand reputation. OB2G listed an example of role reversal:

> There is a shift where Apple would now validate the operators' network, instead of the network validated the device. It is a reversal of roles. Apple, for example, refused to validate LTE on their phones unless they could be comfortable that the network could support the device.

The larger OEMs want to ensure that their product performs seamlessly on the operator's network and conduct interoperability testing extensively in this regard. In the example listed with Apple, the operator took a decision to make certain features unavailable on their device until they were confident of the network's ability to support the device technology. This was and still is the domain of the network operator, who routinely conduct further interoperability tests with EC equipment before offering them for sale on their networks. Both these types of testing (by the operator and OEM) are additional tests to the EA mandated requirements. OB2G further stated that as much as 40% of the ICASA approved EC devices submitted to the network operator, fail interoperability testing and are not sold by the operator. OR1A supported that statistic and noted that the ICASA approval did not guarantee the functionality of the device. Operators conduct a "health check" of the device and not necessarily a "deep dive" test of the equipment (OR1A). Such functional testing has repeated showed that international approvals, although a necessary first step to permitting equipment to operate on a network, did not necessarily indicate that the equipment is fit for use on a South African network. OR1A noted that it would be important for the regulator to have access to such test facilitates if only to verify the functionality of the equipment.

4.24 The current EA approach to standards

ICASA has a list of standards regulations that details the technical requirements of EC equipment EA. ICASA considers this document a "living document" that is updated annually if necessary and is of the opinion that it contributes to the local standards development and process. ICASA defines the standards and declares the compulsory standards required for approval. ICASA sometimes needs to explain the standards requirements to suppliers, but it is generally clear to the laboratories (RN2A, RM1K, RD8M, RN6B).

RM1K raises a key point of 'differentiated suppliers', where the current approach appears to work well with the larger suppliers. The level of trust (regarding test report acceptance) that ICASA assigns to the larger suppliers seems to higher than what is assigned to the smaller suppliers (RM1K, RN2A, RG5N, RN6B). It should be noted that the list of standards that ICASA applies to the EA process is not exhaustive. ICASA generally uses ETSI, CISPR and IEC standards as a benchmark, although ICASA may accept other standards, bearing in mind the frequency arrangement of the standard submitted.

4.25 The current EA approach and consumer protection

RM1K felt that the current EA approach provided just a 60-70% confidence level in protecting consumers. ICASA could not guarantee that every device confirms to the full functionality as required by the EA process. However, the process does show the ICASA label, and the consumer can make a decision to purchase or not. ICASA penalises suppliers that do not affix the ICASA sticker, but unfortunately, there seems not be a mechanism actually to verify the authenticity of the label.

OH1M raised a point that the consumers look for the ICASA EA certification, and the certification process has enough rigor built into it to ensure quality EC equipment, hence the EA process does lend itself to consumer protection. SN4M supported this position and stated that EA approval serves as a mechanism to prove quality, as the EC equipment is subjected to varies levels of compliance checks, which ensures that the final product is of a high quality. This in turn serves as a consumer protection mechanism by ensuring that only quality equipment can be sold to the consumer.

4.26 Choosing a level of performance of standards

RM1K noted that the actual standard is not interrogated by ICASA and that conformance to the entire standard is required. Each item of the standard is not considered individually, just the overall standard. There is a zero tolerance approach to standards. This highlights a key issue to ICASA's approach to EA regulation, in that conformance to the standards and the integrity of the EA process seems to be paramount (RS3R, RG5N, RN6B, RD8M, RN2A, RM1K). ICASA believes that if the equipment complies with the prescribed standards for EA approval, then there should not be a problem with the equipment. ICASA is aware that the level required for compliance is high, as high as any first world country. ICASA also notes that it is mindful of the fact that it is expensive to comply with all these standards, but is steadfast that such standards cannot be relaxed. In this sense, ICASA does not factor in any mitigating factors to the cost of the device. The sole focus is to ensure conformance of the device without compromise (RN9B, RQ7L, RG5N, RN2A).

RS3R cautioned that South Africa should only apply a standard insofar as to ensure functionality, as anything more would increase costs. With constant improvements in technology, modern digital communications incorporate error correction techniques that do not prohibit errors, as these errors can be corrected by the intelligence built into the EC device. Standards, therefore, should not be applied in a perfect sense to achieve 100% accuracy in the functioning of certain equipment, as this would result in higher device costs.

In some instances, the level of performance in some standards is higher than the international benchmark. TLS2L cites the example of assessing the IEC/ISO 17025, which is a quality management standard for test laboratories. The South African specification has additional "R" documents (SANAS Regulatory documents), which sets higher standards than what are required by other international test laboratories. International laboratories do not need to comply with these "R" documents. Thus this additional requirement serves to improve the overall level of quality of local testing done in South Africa. TLS2L stated:

> We even have East African Laboratories that request SANAS assessments, for which they had previously been assessed by European assessors. These assessors now no longer want to assist due to strife and turmoil in these African countries. They are now turning to us to assist. These countries have told us that SANAS is too strict and that the European guys are much easier.

When these additional requirements are explained to the test facilities, they understand and see the value of these additional requirements and then actually support it.

Another natural progression of the EA approval process is related to technology. ICASA staff noted that, as technology advances, new equipment has several Radio Frequency (RF) performance standards applicable to a single device. The amount of RF devices per equipment has increased, (for example, a single cellular telephone can have a GSM radio, a CDMA radio, a Wi-Fi radio module and a GPS radio module.) hence it is becoming more expensive to conduct EA testing. Manufacturers, however, seem happy to comply with these standards as they see the value in compliance (OR1A, OK3H, OB2G).

Figure 22 is a depiction of the level of standards value chain based on the evidence gathered.

Figure 22: Level of Standards

4.27 The current EA framework in terms of credible and stability

Respondents generally thought that the current EA framework was credible, but not fully in the sense of standards as no testing is done locally. ICASA has to rely on third party test reports and cannot independently verify the authenticity of these reports. Reports can be forged, hence the confidence level and credibility is not 100%. ICASA cannot guarantee that all equipment that makes it onto the market is type approved, and this impacts the stability of the market (OB2G, OK3H, RN2A, RQ7L, RM4J). This raises the trust and verification issues once again.

RN2A cited the example of the "simplified" type approval process, in which a supplier may request approval of a previously approved device, without the requirement of providing the requisite test reports. In this process, RD3M & RN9B noted that there was significant fraud detected, almost exclusively dealing with smaller suppliers. These suppliers attempted to claim access to test reports that did not correspond to the device that they were trying to approve, as well as falsely declaring equivalence between their product and a previously approved product. These incidences of fraud seems to have further entrenched ICASA's position regarding the level of trust with smaller suppliers (RM1K, RN2A, RQ7L, RM4J). ICASA does not believe that the market is sufficiently mature to allow a self-declaratory regime based on the issues of trust.

RN2A was of the opinion that the EA process is clear and precise, as it details the method of approach of the Authority. RN2A, however, again raised the issue of a 'differentiation of suppliers'. It seems to ICASA that it is easier for manufacturers and laboratories to understand and comply with the EA process, but more challenging for importers and retailers, in particular with technical standards. There seems to be a lack of technical personnel within these suppliers that do not understand the requirements and do not provide the necessary documents required for EA approval. This lack of understanding then adds to unnecessary delays in the EA process.

OZ4P provided further input by explaining the key reason for the differentiation of suppliers. Small and medium suppliers do not have access to in-house test facilities that the larger suppliers generally have. They are forced to rely on independent test facilities to provide test results for conformance purposes, which is further compounded by the fast product life cycle of EC equipment. OR1A, IOG4P & OB2G supported this view and pointed out that the cellular operators conduct their own testing on products for to be used on operator networks, to ensure conformance and interoperability. This testing is in addition to the international testing that the manufacturer conducts.

Equipment suppliers agree that the EA process itself is clear, but is a matter of interpretation. They hold the position that it seems easier for technical people to understand the EA process. An example of when a wrong standard has been applied by the supplier as a submission for

EA, which then adds to the costs of conformance and compounds the complexity of the process for non-technical people. Constant liaising with ICASA to clarify the interpretation of the EA approval rules adds to the administrative burden, and ICASA seems not to encourage this dialogue (SD2M, OR1A, OB2G, OK3H).

4.28 Conclusion

There were several insightful themes that are already evident from the data thus far. There is a train of thought that extends to the way in which suppliers should be considered which posits that all suppliers are not equal. The second emergent theme centres around the validity of data sources made available to the regulator. Using the extensive data gathered in this chapter, it is also evident that the investigation into the shortfall of current theoretical approach spanned several different areas. The data collected from the review of the legislative framework was also useful in understanding the intent of these documents. A thematic approach was adopted in reporting the data, and this method will be used in the next chapter as well. Keys themes and initial codes have been noted and will be further interrogated in Chapter 7.

Chapter Five: The characteristics of a developing country

5.1 Introduction

The aim of this chapter is to provide data for the second research sub-question of this study:

> *Why are the characteristics of a developing country unique and how can these characteristics be considered when developing an innovative theoretical approach to regulating EA?*

This chapter lists and investigates the attributes of a developing country and first determines whether these characteristics are unique and secondly investigates the impact that such attributes would have, when considering an innovative theoretical approach to EA. The nature of innovation is also studied, with a specific focus on differentiating between technology innovation and developing regulatory innovation. Innovation is a key theme of this chapter and has wide-ranging implications when contemplating future regulatory regimes. The generalisability of a developing country is studied further in relation to the published literature, providing data on an alternative approach to dealing with developing country factors. The final section investigates the balanced approach between developing country imperatives and an innovative approach to EA regulation.

5.2 Characteristics of developing countries

RM1K asserted that there are characteristics unique to a developing country and listed literacy and skill sets as examples. South Africa still consumes products from other countries and lacks in industrial development. RM1K used the phrase 'technological colony' as an economic term to describe the impact that Europe has on South Africa's EC equipment industry. RM1K further listed high unemployment and low economic growth as well as poverty as unique characteristics of developing countries.

RN2A and RG5N also noted unique features of a developed country, where reliable manufacturers and a proper framework for EA exist. They noted that developed countries have heavy penalties for non-conformance and that suppliers are required to manage their own EA process. This self-management is opposed to the South African environment where this process is largely driven and managed by the regulator. This subtle shift in responsibility is significant, as the costs of proving non-conformance lie with the regulator. The regulator would ordinarily have no basis to declare the quality of a piece of equipment, other than the test reports submitted by the supplier. The relationship in first world countries is based on trust first, rather than proof of compliance upfront. Proof or verification is required only when there is a problem. The penalties for non-compliance seem to serve developed countries as an adequate deterrent to prevent false declaration. This approach is not a viable option for developing countries as they do not have access to test facilities or funds to conduct compliance testing. In developing countries, the regulator has thus to take problems taken back to the country of the manufacturer (usually a developed country) rather than solving them in-house. This inability to solve problems locally perpetuates to the 'technology colony' mindset between developed and developing countries.

Other commentators suggested a solution to this issue (albeit a long term one), as implement in-house testing and to build relationships with other test facilities (OR1A, OB2G, SD2M). This approach is in keeping with the emerging theme of cooperation and collaboration. The rationale for suppliers to support such collaborative attempts seems to be rooted in a self-interest motive rather than a public interest objective Suppliers are concerned with reputational damage and seems aligned towards not jeopardising their reputation. TLS2L goes as far as to state that competition between testing facilities in a developing country such as South Africa should not exist, as testing facilities must pool their resources for all of them to survive. As the testing abilities available locally in South Africa are fragmented, no single laboratory can conduct all the required EC equipment testing. Testing laboratories must then share the test burden based on the ability to be fully capable of meeting the testing needs of the country.

There are, however, several unscrupulous dealers in the South African market for counterfeit equipment. These dealers highlight the previous theme of 'differentiation of suppliers', where the perceived lower end of the supply market may be prone violate EA rules as they are inelastic to increasing costs (RQ7L, RN6B, RD3M). Pricing and costs are thus important issues, and manufacturers must be able to provide products to a developing market at the lowest possible prices.

There seems to be a key distinction between South Africa as a developing country and a developed country, as the South African market size warrants us access to the latest EC equipment technology, but the country generally does not acquire the research capability and intellectual capital that accompany such products. Patents sit in other countries, and the only mechanism we can achieve such R&D is via backwards integration (essentially developing a product design by copying the design of the final physical product). The ultimate aim would be to source research capability into the country along with manufacturing, as just manufacturing alone will not helpful (RQ7L, SD2M, TLJ1H).

5.3 Challenges in the EA process in relation to the developmental state of South Africa

RM1K listed literacy as a key challenge faced by ICASA in the EA process. ICASA licensees at times do not understand the EA process and find the requirements difficult to comprehend. Some of these people are very innovative and understand the industry well, and would like to comply with the EA requirements, but cannot do so due to low levels of literacy. It is sometimes beyond their level of comprehension to adhere to the regulations that guide the type approval process in South Africa.

The economic conditions were also listed as a critical factor, as equipment suppliers cannot afford the cost of conformance. Local production of EC equipment is stymied by the high cost of conformance. The economic consideration is two-fold, applying to new suppliers who are prevented from entering the EC market as well as to established suppliers, who are forced to close down due to the high costs of testing (RQ7L, RN6B, OB2G, RG5N, IOG4P). RD3M, however, disagreed with this assessment as the introduction of the “simplified method” of EA approval has meant that test reports are no longer a problem for devices that have been previously approved by ICASA. Testing costs are not applicable as a supplier can simply follow the administrative requirements and be granted EA.

Technological innovation has had the unintended consequence of contributing to the cost of EA approval. Cellular telephones were listed as an example. In the past, these phone had to be tested to just a GSM standard. With the advent of technology, these phones now need testing to CDMA standards, 3G standards, 4G and LTE standards. Each additional technology increases the testing burden required for EA conformance (OB2G, OR1A).

Lack of governmental support for research facilities was listed as being a priority for the government as there is a perception of not having enough innovation within the country (PP1L). The key point made here was that South Africa did not lack the facilities to innovate, but did not collaborate to maximise on the resources that are already present within the country. The Innovation Hub was listed as a resource to maximise. Ultimately, it was suggested that although South Africa faced many developing country challenges, it could still do more via a better mechanism of monitoring, evaluating, collaborating and measuring (RG5N). An example of such collaboration that was listed included the MoU signed with the South African Bureau of Standards (SABS) as a test facility to conduct limited approvals on behalf of ICASA (RN2A, RM1K).

TLJ1H, however, saw this collaboration as an example of what *not* to do. While ICASA is responsible for intentional RF transmitters, SABS (in terms of the MoU) handles all non-intentional RF emissions. SABS has recently changed their approval process and will not accept test reports from accredited test laboratories and insists upon conducting local testing for all products. Their lead times increased from 20 days to 240 days. Such long lead times are untenable to the equipment suppliers, and the introduction of this process has resulted in some suppliers considering selling their products illegally. Suppliers, especially in the IT and EC environment, have product life-cycles of three months. Long turn-around times thus make launching such products not viable for the South African market, as suppliers are not willing to support a product that is obsolete. IOG4P went as far as to say that the EA process is the fundamental reason for so many smaller suppliers illegally selling their products.

SABS also considers all the equipment in the same manner, and the consequence is that a cheap five dollar phone charger is subject to the same tests as a large flat screen television (TLJ1H). The cost of testing amounts to about R600 000 per product. Economies of scale then dictate the final cost of the product, as these conformity costs are passed onto the consumer. TLJ1H notes an example of an oscilloscope, which would see no more than 10- 15 sales in total during that product's lifespan. The testing costs are divided amongst the expected sales, thereby greatly increasing the unit cost of each device.

Collaboration is not limited to testing facilities. SN4M noted that suppliers are happy to collaborate with the regulator to ensure that the regulator is aware of the latest technological trends. This could be implemented through suppliers hosting regular workshops with the regulator, to ensure that the regulator is forward thinking and ready for the types of technology that would be launched in the country within a 6 to 12 month period. This collaboration would allow the regulator to prepare with respect to the standardisation framework required to allow new products into the South African market. Such preparation would complement the regulator's efforts in collaborating with other standardisation bodies both regionally and internationally and may even result in South Africa introducing new standardisation agenda items (SN4M).

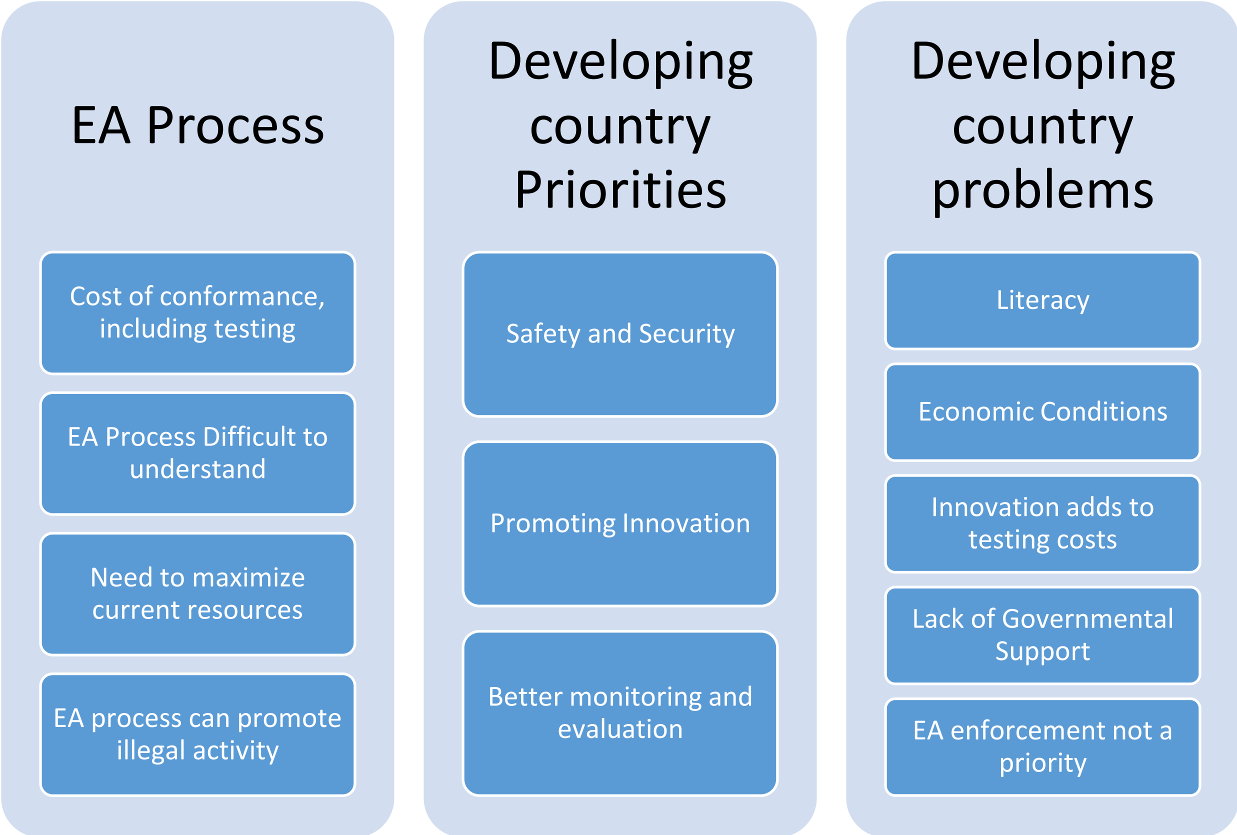
The importance of EA in a developing country seems to be not well understood. RM5S noted that this was particularly an issue for enforcement, as ICASA inspectors are required to obtain a court order before inspecting EC equipment. In most cases, ICASA inspectors request police escorts to execute such warrants. The South African Police have a backlog of high profile cases such as murder and robberies. EA enforcement does not feature prominently in terms of importance to them. Even obtaining search warrants are problematic if the Judge that was approached by ICASA inspectors to issue the warrant, was not familiar with the provisions of the ECA.

IOG4P also agreed that the prominence of EA seems to be overshadowed by other regulatory imperatives, although it should be regarded as one of the fundamental functions of the regulator. ICASA itself seems not to value the importance of EA:

> ICASA does not recognise the work done in interference and type approval (when looking at the strategic plan) and looks at EA as some sort of stepchild. All other spectrum issues cannot be implemented without EA. (IOG4P).

Figure 23 breaks down the EA process in terms of developing country problems and priorities.

Figure 23: EA and Developing country challenges



5.4 Generalisability of developing country concerns

RM1K was of the view that some of these challenges are common, while others are unique. Unemployment and low growth were suggested as examples. South Africa, when compared to larger developing countries such as India, Brazil and China, has a very low level of growth while these countries have markedly higher levels of growth. The policies of the current administration of the country are not conducive to growth, and as such, does not drive growth. The political landscape thus is a major factor in driving growth.

Other commentators listed India, South Korea and Egypt as alternatives where these countries have evolved beyond the development stage. South Korea was listed as an ideal example of a developing country that used technology and innovation to progress to a developed country status. India, although a developing country, was listed as a powerhouse of software development. Egypt, also a developing country, had excellent test laboratory infrastructure. (RN2A, RM1K, RG5N).

The overall takeaway from this discussion was that there is a need to exploit the skills inherent in a developing country through governmental policy. Collaboration either locally or internationally, was suggested as an ideal mechanism to overcome some of the developing country challenges. In that respect, South Africa was seen as somewhat of a “big brother” in Africa, from which other developing countries in Africa requested support. Zambia has currently requested a MoU with ICASA with regards to promoting regional collaboration.

Such requests highlight a seemingly fraught relationship between trust and collaboration, as although South Africa is keen to engage in such bilateral collaboration, it is also uncertain whether the integrity of the EA process can be maintained by all parties. A Bi-lateral agreement is thus a problem for South Africa in terms of the level of trust with its regional counterparts (RN9B, RS3R). SN4M mentioned that:

> The last time I was helping guys from (name removed). They worked very slowly and were not sure of the requirements for different products. I had to show them what test reports applied to the various categories of equipment as well as assure them that the reports I had submitted were indeed the correct ones. The ICASA procedure is way better than them. I had to help them and show them the process. We are very far in comparison to other African countries.

Other SADC countries are still in the process of developing EA regimes, but it is uncertain whether the results from such a system can be trusted, even when such an EA regime is fully functional. Trust is thus a key element to the regulator, not only regarding information supplied by EC equipment manufacturers, but to other EA regimes as well.

South Africa is, however, aware of the opportunity for leveraging trade for its benefit (e.g. through taxes and intellectual property) by entering into such bi-lateral agreements and seems to be sincere in building such relationships based on trust and rigour. South Africa is also aware that other member states would not jeopardise these relationships knowingly, although the lack of expertise and testing facilities may render such agreements unworkable (PP1L).

Collaboration between local stakeholders in the regulatory environment would also be required. OK3H & TLS2L raised a concern that the equipment suppliers are sometimes exposed to a “double jeopardy” scenario. Equipment suppliers pay taxes on the power supply as well as for the device and EA approval. The EA approval is handled by ICASA while the National Regulator for Compulsory Specifications (NCRS) is responsible for the approval of the power supply and issues a Letter of Authority (LOA) in this regard. There seems to be confusion in that area as the power supply of any EC device is attached to the unit and part of the instrument, hence there should be no separation between the power supply and the device. This additional “tax” is ultimately passed onto the consumer and in turn, affects the affordability of the equipment. The solution suggested would be a level of collaboration between ICASA, SARS and NRCS to prevent duplication and double taxation. Further compounding this problem was the added disadvantage of time lost submitting to two different regulatory authorities. TLS2L noted that just the NRCS itself could take up to nine months to issue an LOA, which further adds to the two to six month processing time required for ICASA EA approval. The time lost in adhering to regulatory considerations could amount to a year before the product can be legally sold in South Africa.

South Africa was also seen as being unique in terms of development (RM4J). The level of facilities and infrastructure in the EA environment that South Africa has access to surpasses any other country in the SADC region. In that sense, South Africa’s development state was considered closer to a developed country than a developing country. IOG4P noted that the EA regimes in some SADC countries were poor, making the South African regime seem impressive by comparison. South Africa has a distinct urban-rural divide, where the urban areas enjoy facilities on par with developed countries while the rural areas face the same problems in general as developing countries (OB2G, PP1L). The distinctive urban-rural split is evident by the high GINI coefficient of South Africa. OB2G added that:

> We have a very high GINI coefficient which has led to political and racial tensions in our country. I would not describe us as a developing country. We are a transformative country. We are not 1st world, but neither are we 3rd world. We are somewhere in between. In my research dealing with Fibre to the home, I have found that Europe is lagging when compared to other Eastern Bloc Countries when it comes to fibre to the home connections. We can be compared to these Eastern Bloc countries. We can leapfrog developed countries by not

> holding on to legacy technology. Although we lag behind, we can see this as an opportunity to leapfrog a generation of old technology.

South Africa's unique developmental attributes can be used to the country's advantage, by leapfrogging legacy technologies and adopting the latest technologies such as fibre to the home. Also worth noting was the comments made by OB2G & TLJ1H that the urban-rural split is prevalent in many developed countries as well, with the US listed as an example.

The population of South Africa was also listed as another unique feature that impacted on its developing country status. South Africa contained a substantial percentage of the population that was economically active enough to create a market for EC equipment, irrespective of the majority of the population that was not. This skewed demographic has contributed to the country being exposed to both developed and developing EC market conditions. RM4J cautioned the regulator from categorising South Africa's developing country status, and noted that although it seems that the need for EA diminished the more a country was developed, this trend would not apply to South Africa.

5.5 Contributors to developmental challenges

The regulatory staff at ICASA listed politics as the predominant challenge. The policy environment and educational regime are also not conducive to growing the economy. RM1K noted that South Africa is almost the worst performing country in Maths and Sciences from a survey of 140 countries conducted by the World Economic Forum. The current capacity in the educational system does not support the skills and ability in engineering, which is crucial in the EC equipment industry. Engineering skills are required to drive innovation.

The challenges faced by developing countries are well documented as is the impact of ICTs on development. There seems to be a lack of a concerted policy or governmental support for ICTs in South Africa (OZ4P). While the government can understandably prioritise access to basic services such as education and health services as key governmental priorities, access to ICT services is of vital importance. Policy attempts in the ICT arena seem to have been largely unsuccessful, and an important science and technology project such as the Square Kilometre

Array (SKA) serve as examples where ICTs contribute directly to the GDP of the country. The SKA example also highlights a case of revenue leaving the country, as testing for equipment used in the SKA project is in many instances outsourced, as South Africa does not have the requisite testing facilities.

Also of interest was that ICASA staff stated that not everything is related to funds or the lack thereof. There is a consensus that the EMC market in South Africa as an example, is sufficiently large enough to be self-sustaining. It was felt that the testing environment in South Africa as a whole is largely EMC as this is the focus and market. There thus exists a demand for EMC services and testing laboratories in South Africa have developed a commercial model for this. The innovative solution suggested was to leverage the existing abilities of the laboratories already existing in South Africa, and provide them with funding to expand to other services. ICASA was suggested as the entity best suited to drive this initiative for the country (RN6B, RN2A, RQ7L). OZ4P also noted that the value of incumbent test facilities could not be overstated, as gaining accreditation as a recognised test facility has proven to be a tough task. Existing test facilities were also seen as difficult to move or relocate, as their location is based on favourable radio frequency environments that are conducive to interference-free testing. This further cements the importance of leveraging on existing testing facilities that exist in South Africa.

The impact of labour costs in a developing country was discussed, with OH1M claiming that labour costs do not form a significant percentage of the total cost of EC equipment. Most commentators were of the opinion that labour costs for imported equipment (especially from far eastern countries like China) was lower than the international market rate. This was not seen as a significant obstacle for South Africa to compete with, given that South Africa's labour costs could be considered to be lower than the international average. These two factors (South Africa's low labour costs and the low percentage that labour costs contribute to the overall cost of EC equipment) implies that South Africa as a developing country is not be unduly affected by issues of costs related to labour within the EC equipment market perspective. High testing costs at overseas test laboratories could be used to South Africa's advantage if we can competitively price such services. TLJ1H listed the Restriction of

Hazardous Substances (RoHS) testing which costs about R 300 000 overseas and could be done in South Africa at 25 % less, provided the laboratory can secure repeat business.

General infrastructure such as road, electricity, water and sanitation was mentioned as a challenge to developing an EA regime, should these facilities not exist. This was however not mentioned as appropriate to the South African context. South Africa was described as having a marked urban versus rural divide (OS5J), which was a developmental challenge in its own right, however, this challenge was not seen to be relevant to EA environment as adequate urban facilities existed to support an EA regime (OZ4P, PP1L).

5.6 Differentiation of suppliers – a consideration for a developing country?

RM1K thought that the Department of Trade and Industry, as well as the Department of Science and Technology, need to look at introducing measures to encourage local industry and make the EA process less cumbersome. Support for SMMEs is required through subsidies. All ICASA staff interviewed with just one exception, clearly stressed that the ICASA requirements for EA could not be watered down. EA was seen as critical for conformance through standards. Also interesting was that most operators and suppliers agreed with that assessment as well (OR1A, OB2G, OK3H, SD2M). This interesting finding highlights the importance of setting standards at the international levels, irrespective of the fact that South Africa is categorised as a developing country.

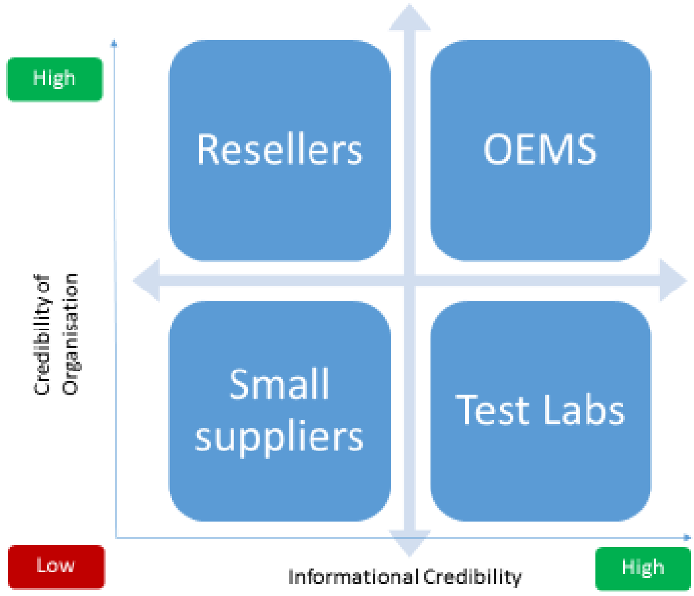
RM1K further suggested that the EC equipment market in South Africa is predominantly controlled by entities with "deep pockets". This in turn creates an opportunity and market for "grey market" products that are imported into the country through the "official suppliers". This 'differentiation of suppliers' theme has been discussed earlier, and the idea is extended to the regulatory framework that exists in South Africa. ICASA staff affirmed that although there are several international EC equipment suppliers in South Africa, these suppliers are all required to have a relationship with a local South African registered reseller or to be registered as a company in South Africa itself. These clauses ensure that these companies pay taxes in South Africa and create employment locally. RM1K related an incident that occurred at the 2016 World Mobile Congress in Barcelona, where RM1K was approached by representatives from several different equipment suppliers, and the general reaction from these suppliers was that the EA process in South Africa was difficult to adhere to. These companies would therefore not invest in South Africa purely based on business economics. These companies alluded to the fact that they needed to be quick to the market and be as cheap to the market as possible. These suppliers would rather choose an easier market than invest in South Africa. This approach, in turn, creates a niche market for the second tier of vendors who can import equipment into the country, without being the "official supplier" of the equipment.

Other regulatory staff members would support the idea of crafting different rules to distinguish the level of suppliers further. As ICASA believes that compliance is ultimately the most important factor to EA, the issue lies in the mechanism to prove compliance. Several commentators thus suggest that the EA regulations differentiate the way that suppliers are dealt with, allowing a greater level of autonomy to the larger suppliers while at the same time ensuring that a high degree of compliance for smaller suppliers remains (RN2A, RN6B, RQ7L, RD8M, OZ4P, SN4M, SM1E, IOG4P). One possible approach could involve creating a "trust matrix" for suppliers based on several categories:

i. Potential reputational damage for the vendor. The argument here was that reputational damage due to non-compliance could be viewed as the ultimate penalty for non-compliance with EA rules. The reputational damage is linked to the organisation's credibility and the term used in Figure 24 is "Organisational Credibility".
ii. Differentiation between Original Equipment Manufacturers (OEMs) and resellers. This again relates to the reputational damage to the brand value. OEMs would be considered more likely to be trustworthy, given the brand value of their product. Test Laboratories would also have high informational credibility, but would not necessarily have a reputation to protect in the country where the equipment is being sold.
iii. Tiering of resellers. Resellers were sometimes licensed by the OEM to sell products exclusively under licence in a country. Such licensing restrictions would serve to protect the brand value of the EC equipment, thereby increasing perceived level of trust with that reseller. The informational credibility in this instance would not be as

high as an OEM, given that test reports could be sourced through other channels other than the OEM.

Figure 24: Trust Matrix



SM1E had once approached both ICASA and the NRCS to determine whether their products had ever caused interference or related problems. The regulators were not able to answer the question posed.

RQ7L, however, advised caution in differentiating between suppliers, as this may entrench the market position of OEMs and larger suppliers. Smaller suppliers may not have the financial resources to access information required for the EA process, such as test reports relating to the equipment being tested. The tiering process would thus result in an easier EA process for the larger suppliers, while the smaller suppliers would have to conform with the various EA requirements that currently exist. Smaller suppliers may exit the EC equipment market in South Africa, decreasing competition in the market.

IOG4P also cautioned that larger suppliers might adhere to EA regulations only if the sanction for not doing so, is large enough. A large holding company for several well-known retailers and wholesalers, Massmart PTY (LTD) was cited as an example of a reputable company that was fined by the Complaints Compliance Committee for non-compliance to the EA regulations. The fine amounted to R100 000, of which R60 000 was suspended. Massmart probably accepted the sanction as it may have made more economic sense to them to pay the fine rather than to follow the EA process. IOG4P conceded, however, that Massmart might not have been aware that they had contravened the EA regulations until it was pointed out to them by ICASA inspectors.

5.7 Lessons learnt with the EA process

The overall consensus from most commentators was that the intention and objectives of the SA EA process were good, but required other structures to ensure that it was not burdensome. The current EA process in SA definitely required a review and local network testing capacity was required as part of that overhaul.

While the self-declaration option of EA approvals, used extensively in first world countries, would seem to be a logical progression path for EA in South Africa, the majority of actors interviewed did not support self-declaration in the current environment, given the fact that the infrastructure required to support such an EA approach did not exist in South Africa. Some commentators conceded that exemptions to the EA process were a possibility, but there would be a need to strengthen market surveillance to ensure post-approval conformity with EA. The enforcement framework would require strengthening as a closed loop from pre-market testing to post-market testing must exist.

Other countries invest in standards and conformity, and OEMs use the testing framework gain a competitive advantage through comparisons with similar products from their competitors. This testing framework was suggested as a goal to be encouraged in South Africa as well. The FCC was cited as the best example of using this testing framework as they have many representatives conducting EA on their behalf. The FCC model was regarded as an excellent one since it makes the EA process easier for a “good” suppliers and challenging for the one that does not follow the rules. This 'differentiation of suppliers' would also mean that only new technologies go through a rigorous testing phase as previous test reports for older technologies would be permitted. This mechanism was thought to provide a balance in the testing environment (RN2A, RQ7L, RN6B).

OR1A, however, disagrees that EA is used as a competitive advantage by suppliers. EA should be a collaborative effort between all equipment suppliers to prevent a duplication of the EA process. Currently, EA is issued to a particular supplier or entity and is not issued to a particular model of equipment. This implies that whenever different suppliers import the same equipment, each supplier would have to apply individually for EA. By collaborating with each other, suppliers can submit a single EA application that would prevent duplication, allow for a quicker time to market and reduce costs associated with the EA process. OR1A listed the example of the three cellular operators, who each apply individually for EA for the same piece of network equipment via the vendor that they are working with, duplicating the EA effort and wasting both time and money. SM1E cited an example of this currently occurring, where 32 different brands collaborate by working together on a "regulatory committee" to streamline approvals for all parties. This approach also prevents duplication and reduces the overall processing time.

5.8 South Africa's developmental state vs administrative efficiency

RM1K was of the view that South Africa's developmental state has affected the skills base in South Africa, and as such, the confidence level in the EA process is not 100%. There is general acknowledgement that there is limited competency in the EA environment, as well as the engineering environment in general. This seems to have certainly affected the efficiency of the EA process. Training new staff in this area, although seen as a good idea, was mentioned as an area that ultimately leads to loss of productivity during the training sessions.

TLS2L had a slightly different view and stated that South Africa did have the required skills in the EA environment, but these skills were more of a general nature. This is in contrast to countries in the EU, where the markets are large enough to support having individuals with specialist skills in the EA environment. Specialist skills are required in the EA environment, especially in terms of supporting and contributing to the standardisation environment. PP1L agreed that specialist skills are needed in the EA environment, but cautioned that the small size of the EC equipment market in South Africa does not warrant a need for such specialised skills. The Digital Terrestrial Television (DTT) set-top box project was cited as an example of a three to five-year project, which is relatively short in duration. Such projects may require specialist EA skills, but the term of this project does not warrant dedicated EA competencies in a small EC market like South Africa.

RN2A had a different view and was of the opinion that issues around administrative efficiency with regards a country's developmental state was not applicable to SA. The current administrative staff was seen to be highly skilled and efficient. They were acutely aware of delays in the EA process, but were simply overwhelmed by the volume of the applications. Volumes were seen as the biggest source of pressure and problems of the EA process in South Africa. The focus to improve administrative efficiency would be to deploy technology with the aim of maximising efficiency and to automate the process. OK3H concurred with this view and listed the example of South Africa's active participation in various International standardisation activities as evidence of the level of engineering skills found locally.

Another key point raised spoke to the core of the administrative problem itself. Some operators were of the opinion that the current EA process was largely a paper-based exercise. The regulator is obliged to accept a summary of the test report and base the decision to approve the equipment or not thereon (OS5J, OR1A, OB2G). This exercise was seen as a duplication of resources, as the equipment would have been tested in other jurisdictions. Operators could thus not determine the value of interrogating a test report versus accepting a declaration of conformity, as the regulator does not have the means to verify the technical aspects of the test report independently.

Automation was seen as a key resource to make the EA process more efficient (RM4J, OB2G). Automation allowed the EA process to handle larger volumes of applications using few resources. The current EA process was seen as a hybrid system, which relied on IT infrastructure for database recording and capturing, but was still largely a manual process. An automated system that was web-based, could provide real-time decisions on EA applications, process applications online, process payments online and email certificates immediately at the end of the EA process. Such a system was seen to be capable of largely removing most of the administrative inefficiencies that are inherent to the current EA process. ICASA staff noted that the regulator was in the course of acquiring such a system, although it formed part of a larger modernisation program that is ongoing at the regulator. OB2G was of the opinion the EA process was acceptable as it currently is and that the biggest issue with Industry with regards to the process was the administrative efficiency.

An interesting point raised by RN6B also relates to a perhaps unintended consequence of the inefficiency of the EA process. As the current EA regulations do not recognise previously approved equipment, multiple EA approvals for the same equipment does occur. While this is administratively inefficient, each additional approval was an added source of income for the regulator. This relates to the comments noted earlier, made by other informants who questioned the EA process as a rent-seeking initiative.

The regulator is acutely aware that the administrative efficiency of the EA process impacts the economic stability of the equipment supplier. Delays in the approval process inflate storage costs at ports of entry for the equipment supplier, as EC equipment is only permitted into the country by the Customs and Revenue Department on presentation of a valid ICASA Type Approval certificate (RG5N). Suppliers, however, are of the opinion that ICASA does not fully appreciate the impact of delays to their business (SN4M). The concept of “time is money” was used to describe the supplier’s view of delays in the EA process. Even though ICASA claims to be mindful of the impact of delays, suppliers have taken a somewhat cynical view and feel that ICASA seems to be paying “lip service” to their concerns (SN4M, SD2M, IOW2E). The “time is money” concept impacts their business, resulting in sometimes significant financial losses due to delays. More concerning was the notion that certain suppliers, desperate to release their products onto the market, may resort to illegal means to do so (RD3M, RQ7L, OR1A). This reveals a significant amount of tension within the EA environment, as suppliers, although intent on lawfully approving EC equipment, are being forced to resort to illegal means out of sheer frustration with the current administrative process. OR1A noted that the

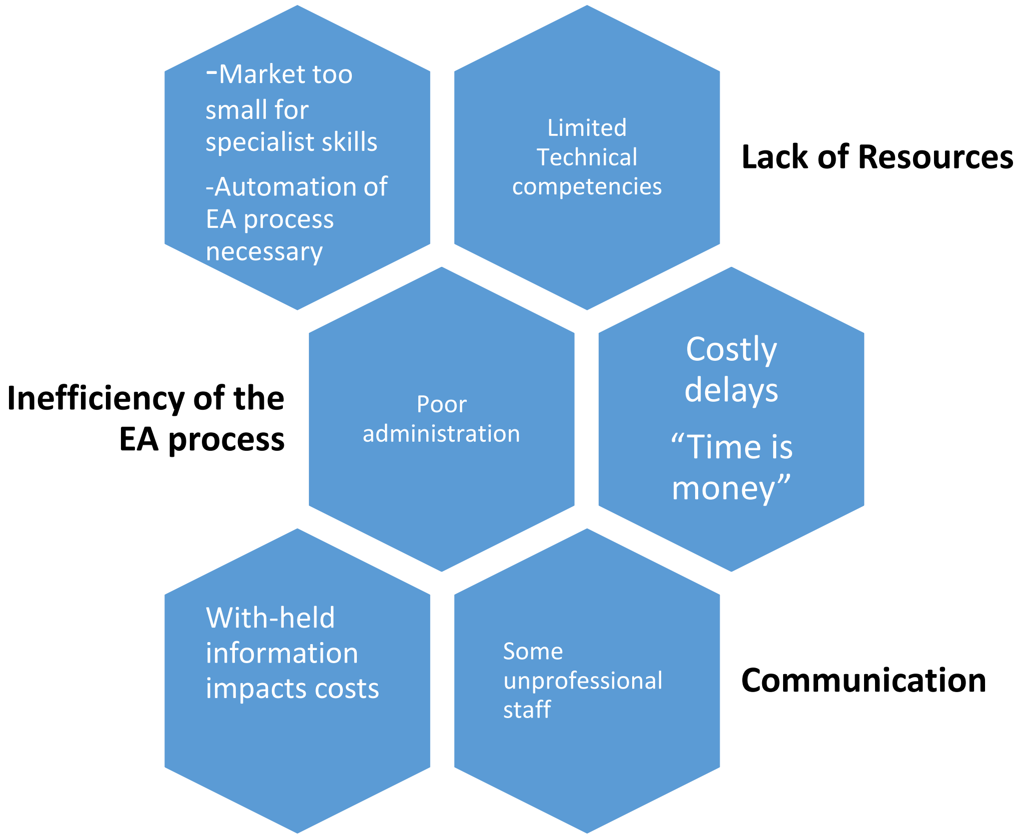
EA process might be inadvertently supporting the trade of illegal EC equipment into the country as the EA process is frustrating, expensive and difficult to understand.

Equipment suppliers, in particular, were severely critical of the administrative efficiency of the current EA process. SN4M added that the lack of guidance impacted the costs incurred by the supplier:

> For a long time we had applied for both TA and TE approvals for a product with both wireless and wired interfaces, when one-day an ICASA staff member asked us why we did not just combine them into one TA application. This saved us an enormous amount of money as we did not have to do five separate approvals for a device with these five interfaces. We just had to include these interfaces in a single approval at 1/5 the previous cost! The lack of guidance from ICASA cost us a lot of money, we need ICASA approval and have no other options (SN4M).

Equipment suppliers and operators attributed the administrative inefficiencies to a lack of resources, primarily human resource capacity at the regulator to handle the large volumes of EA applications. SD2M noted that it was a frustrating experience to even get hold of the EA regulatory staff and almost impossible to get timely feedback from them. The entire EA process was described as “unprofessional, chaotic and a nightmare” while some of the staff at the regulator were described as being “rude, unpleasant and unhelpful” (SD2M). There were, however, several other staff members that seem to try their best to be assistive despite being “overwhelmed by the sheer quantity of applications received” (SD2M). This lack of communication and guidance from the regulator is perceived as a regulatory risk by international manufacturers, who will not ship their products to South Africa without certainty with regards to the regulatory requirements. This in turn impacts the investment these manufacturers are willing to make in the country, with the manufacturer opting to invest elsewhere (SD2M, SN4M). Figure 25 depicts the key issues highlighted in terms of SA’s development state vs. administrative efficiency.

Figure 25: SA's developmental state vs. administrative efficiency



5.9 South Africa's developmental state vs trade

RM1K noted that the EA regime has had a significant impact on trade as it impacts the trade of EC devices in general. There is a small portion of export of EC equipment, therefore there is generally only a one-way trade of goods coming into the country.

Other commentators believed that the development state of a country did little to impact trade in that country, given the fact that goods and services imported to a country will have to comply with the rules and regulations of the receiving country. As EA imposes rules only on importing, its impact on trade in this respect may be negligible (OH1M).

Facilitating regional trade was suggested as a mechanism for developing countries to leverage on EA frameworks that already exist. The SADC region was noted as having existing policy and governmental support, which could be leveraged upon (OZ4P). A regional EA regime has been mooted for some time within the SADC region and would serve as a central point through which all EA approvals for the area could be processed. This initiative seems not to have gained much traction over the years, possibly due to reservations that South Africa has with the ability of other member countries to conduct EA verification to an acceptable standard. This relates to both the issues of confidence in the EA process as well as the lack of facilities to perform conformance testing.

Regional specification of standards may act as a barrier to trade in a global market (OS5J). Smaller markets may suffer if the standards in their ITU region does not fall within a larger region (such as ITU Region 1 in Europe). Thus, any small incremental costs would prevent certain suppliers from trading with a particular country, if the cost of compliance outweighs the potential benefits. This is not a problem for mass market equipment such as cellular telephones, as the economies of scale make it viable for the vendor to comply with local conditions. Developing countries thus do not represent a niche market for EC equipment. The alternative is smaller volumes of equipment sales at higher prices, with the end user ultimately bearing the brunt of these higher prices.

The fact that EA is based on an ITU region means that the EA process is in itself very specific to countries that belong to that particular area (TLS3T). EA thus acts as a barrier to trade by design, as the network characteristics and frequency bands used, differ from region to region. Equipment approved for use in region one will thus not function correctly in a region two country. A worst-case scenario would be equipment meant for one region causing harmful interference in another region. This had occurred in the past, when cordless telephones meant for ITU region two were sold illegally in South Africa, causing major network interference to the Vodacom cellular network (TLS3T).

5.10 South Africa’s developmental state and the quality of EC equipment

Several commentators thought that the developmental state does not affect the quality of the EC equipment (OR1A, TLJ1H, PP1L, RM1K, TLS2L). The rationale provided was that most of the equipment is manufactured overseas and imported to the country, hence the quality is determined by global factors, not South Africa’s developmental factors. An interesting point raised by RM1K however, was that that certain specialised features of EC equipment might be removed prior to sale in South Africa by the EC equipment supplier, to make the equipment more affordable to the South African market. Affordability is thus a key determinant of trade.

Equipment suppliers need to be able to offer a differentiated product to differentiated markets in terms of developed vs. developing countries. OH1M agreed with this assessment and stated that South Africa's socio-economic factors created an environment in which grey market products thrived due to their low cost and functionality being suited to the market conditions. Grey market products were not illegal products and were sometimes referred to as "parallel imports", where EC equipment is imported and sold in a country via a vendor, who is not the official supplier of that equipment (OR1A). The current EA framework allows any supplier to import any equipment and hence does not differentiate between grey market products and "official" products. It was noted, however, that grey market products in most cases, by virtue of being cheaper than the OEM supplied equipment was more prevalent in developing countries than the "official" equipment (OR1A). This was problematic to the network operators and official suppliers, who are not liable to support such equipment should it prove to be defective when used on their networks. Further, official suppliers generally optimise equipment destined for the South African market to the appropriate standards and specifications. Grey market products are typically not optimised, leading either to degraded operation of the equipment, or in a worst case scenario (for the operator), a degraded network (OR1A).

Although the trade-off between the price and quality is a reality for consumers, it is also dependent on the application of the device. Certain areas such as safety of life (e.g. aviation radios and maritime radios) are non-negotiable, and no compromise can be made on the quality of the device (OZ4P, TLS3T). Even interference caused by other EC equipment has to be managed to prevent interference to these safety of life radio equipment. There seems to be no consensus on a consistent process to treat all equipment, except that a carefully managed approach to device quality was required. The regulator would thus have to consider several variables, intrinsic to the market conditions to consider an EA approach that caters for the quality of EC equipment.

Equipment suppliers raised the issue of counterfeit equipment. Counterfeit equipment was regarded as illegal equipment and although it was not seen to be covered under the ambit of EA approvals, it seemed to be a significant factor in the EC equipment market of a developing country (OH1M, OS5J, OZ4P). Counterfeit equipment differs from grey market equipment in that it cannot be EA approved by virtue of being illegally manufactured. Counterfeit equipment seems to have found a similar space in the market as grey market products, based on attractive pricing that matches the market demand. OR1A & RS3R saw the Customs and Excise Department as the principal party responsible for ensuring that such equipment did not enter the South African market and called for a better working relationship between the South African Revenue Service (SARS) and ICASA. Such as relationship should serve to assist SARS officials to better differentiate between counterfeit equipment and ICASA approved equipment, and should entail SARS having primary access to the ICASA database of EA approved equipment. RS3R cautioned that even a single device bought overseas and brought into South Africa could be extremely problematic:

> People going overseas and buying EC equipment is also a serious problem. Their devices may not be compatible with our spectrum arrangement. They may work well but operate in bands that are not authorised in South Africa. A typical case would be a two-way radio, which can interwork with each other but can cause interference with other licensed users. A 167 MHz Public mobile two-way radio was supposed to work in the 446 MHz – 446.1 MHz, but it looked identical to the proper PMR 446 MHz radios approved in South Africa. The power level is 500mW with an outside range of 3-4 Km! (RS3R).

RS3R cited the same example as TLS3T, of just one pair of public mobile radios that caused significant interference in the Cape Town, effectively preventing GSM communications in a particular area.

Dumping of obsolete equipment was also to be a major problem in South Africa and contributes to the issue of e-waste as well (OZ4P). The same reasoning applied with grey market and counterfeit products, being that developing countries were price sensitive and cheap EC equipment would always find a market share. Unscrupulous suppliers use this to their advantage and dump obsolete equipment in developing country markets.

5.11 Policy support in a developing country

RM1K noted that the total budget that the government spent on ICT research and development declined over the past ten years, rather than increased. This had a significant negative impact on innovation. Innovation requires financial resources and governmental policy to improve in South Africa. This reiterated the theme of governmental and strategic support to the EC equipment market. Other commentators noted a disconnect between Research and Development (R&D) in South Africa, as there is no feedback loop between the R&D institutes and the equipment market (RN6B,OS5J,OH1M). There exists no platform for the sharing of knowledge and information. Forums to drive innovation were suggested as a necessary step, and ICASA was proposed as the body to set up such platforms. This lack of financial support through policy initiatives has contributed to the fact that very few organisations and individuals are actively involved in EC equipment R&D in South Africa. The country thus becomes a "technology colony", inheriting technology from imported equipment without gaining intrinsic knowledge related to that equipment (RN6B, RM1K).

OH1M made the following remarks around political and policy support, with a specific focus on empowering the local manufacturing industry:

> We would need some subsidy based upon governmental policy support for our local manufacturing industry. This could form part of the larger Industrial policy of the country. I'm afraid that this may not be a straightforward issue as we need first to increase our manufacturing base by policy. Government could have incentives for manufacturers, such as special economic zones. Like the car industry. Export support as well. Specialist support to manufacturers to local manufacturing to expand our regional economic activity. For e.g. In SADC, we could remove barriers to trade in regional trade. Set-top boxes for digital migration is another example. The government had the right idea, but the execution was poor. SA has not produced the correct amount of set-top boxes, and SA was not able to generate the set-top boxes for the rest of SADC and Africa (OH1M).

OH1M cautions that although governmental policy would be a step in the right direction, it would have to be carefully thought out and executed to avoid failure in achieving the economic objectives of the policy.

5.12 South Africa's developmental state and competition

Most informants noted that the state of competition in South Africa was robust. There were challenges that South Africa faced in terms of innovation as discussed earlier, but this was seen as an opportunity for further innovation and increased competition in the market, as the current EC market was not considered to be saturated. Competition was considered to be unfortunately mutually exclusive with innovation. Solutions suggested by informants to drive innovation included collaboration - people need to collaborate to remain relevant. Information sharing was listed as being central to collaboration and ICASA was listed as the ideal central point to drive competition. In essence, collaborate was listed as a key success factor in driving competitive.

Other informants, however, had a differing view, as they felt that competition itself drove innovation (OZ4P, TLJ1H). Consumer quality was seen as a determinant of consumer choice, hence the Quality of Service with regards to EA equipment would improve with competition in the market. Price sensitive consumers in developing countries hold on to their EC devices for longer periods of time and expect more from them (OZ4P, OR1A, RS3R, IOG4P). If one compared the entry-level phones from a decade ago to the basic phones of today, one can clearly see that the features available on these phones have increased dramatically, without an associated increase in relative price. Consumers are getting more value for an equivalent investment today, based on competition in the market. Using the example of the cellular phone, the number of manufacturers in this market has increased more than tenfold during the same period, substantially increasing competition in this space (OR1A).

5.13 South Africa's developmental state and consumer protection

There is a lack of capacity as previously discussed to conduct specific testing, leading to a low confidence level of the EA process. This in turn negatively affects consumer protection efforts which thereby opens a market for inferior products. This is a funding issue that is linked to South Africa's lack of funds as a developing country - South Africa's focus is still on financing infrastructure for basic services, and building local testing capacity is not considered a basic service (OB2G, OZ4P, RM5S).

The opposing view was that South Africa's developmental state did not impact on consumer protection issues at all, since the levels and standards set for South Africa with regards to EA approval do not differ from developed first world countries, hence the same quality of EC equipment can be expected (OH1M).

The lack of a strong consumer advocacy groups in South African was seen as a further reason for ICASA to protect consumer rights (OZ4P, TLS2L, TLJ1H). Consumer protection was noted as being more important than protecting networks. ICASA is mandated to regulate in the interest of the consumer. Networks have many fail-safes to protect the network, but the regulator was seen as the last line of defence for the consumer. There are not enough consumer advocacy groups in SA to effectively advocate consumer protection, hence the consumer would rely more heavily on the regulator to provide an adequate level of protection.

A surprising result was the view from EC equipment suppliers on the benefits of EA regulation. While the objective of EA regulation on consumer protection is well documented, SN4M also lists EA regulation as protecting the supplier as well. EA approval is a legally binding declaration from an independent third party that verifies that the equipment supplied by the EC equipment supplier, meets all regulatory requirements of that country. Suppliers use this fact against claims that may arise from consumers, should there be any legal challenge regarding the functionality of the equipment. A good example was the Samsung Note 7 phone, which developed catastrophic battery failures despite receiving EA approval in countries around the world. The supplier could thus argue that due diligence regarding safety was applied as warranted by the EA approval, and the supplier could thus not be held liable for negligence. The EA process therefore serves as a mechanism to protect both the supplier and the consumer.

SM1E commented sarcastically that the EA regulations in South Africa certainly protect the consumers since the process takes so long, it eventually prevents the consumer access to new products. The consumer is hence well protected as they are prevented access to these products.

5.14 Determining the appropriate level of performance standards for a developing country

As previously discussed, the approach that enjoyed support from most informants was that ICASA should not tamper with standards, and that international standards must be adhered to. Lowering standards was seen as an invitation to open up other unforeseen problems, and the requirements for EA approval should always remain high. Compatibility and interoperability issues were listed as potential areas of concern. Some commentators even suggested that lowering standards may increase the cost of EC equipment, as they would require testing to unique standards (as opposed to the accepted international standards) which in turn would drive up the costs of conformity assessment (RN2A). The integrity of the standards and the EA process seemed to be the key theme. ICASA, in particular, felt that there should be no compromise on standards, and that the focus should rather be on making the EA process easier, not less demanding. The requirements for EA should be aligned to global levels and not on creating a "watered down" version. The mechanism of conformance is at the core of the issue (RM1K, OH1M, RG5N, RS3R, RN6B).

A differentiation of performance standards for a developing country would also serve to exacerbate the digital divide. It was noted that the services consumed by both developed and developing countries are the same. This also applies to rural and urban areas of a country as well. There is thus no rationale to differentiate the quality performance standards applicable to developing countries and rural areas (OH1M, RS3R).

The point is clearly made by several commentators that the level of standard ultimately impacts the price of the EC equipment. Setting standards would require a cost-benefit analysis from the regulator, to ensure that public interest objectives are met at the right economic considerations. Market conditions were seen as the best mechanism to gauge the economic climate. The focus of standard setting should not be on *what* standards (i.e. either local or international) to apply to EC equipment, as the prevailing theme suggests that international standards should be the norm. The focus of standards would rather be on *which* standards (i.e. core functional standards vs. service standards) should be applicable, as extending the mandatory requirements for EA approval beyond basic functionality was guaranteed to increase EC equipment prices (OH1M, SD2M, RG5N, RN6B, IOW2E, RM4J).

OS5J, however, notes an important caveat to blindly accepting international standards as the regulator generally does when adopting standards that apply to South Africa. In Europe, standards can be fairly easily changed and replaced based on their requirements and these requirements may not necessarily apply to the South African environment. It is thus dangerous to align South Africa to an automatic update of standards. This is not a problem of the actual process, but it is important to specify what the South African requirement is. Adopting the latest version of a standard may also substantially increase testing costs, without an appreciable gain in the functionality of the equipment.

Another interesting point raised by OS5J related to the mandatory functional requires for EA equipment:

> Even if a piece of equipment complies with the basic EA requirements, the “bell and whistles” that relate to the equipment is not tested by the EA process. It is this additional functionality of the box that causes the problems to the end user, not the actual basic conformance requirements (key interfaces). An example is an ADSL modem, where the additional features cause most of the problems. The TR069 (testing and configuration of ADSL modems) standard is not a mandatory requirement for modems. Network operators use this test as a network functionality testing specification. This is not part of the EA process, hence no recourse if it does not work (OS5J).

This comment raises two important issues. The first is that the basic testing required in terms of EA approval is not always indicative of the full performance of the equipment – it represents a small subset of all the possible performance standards that the equipment could be tested to. In that sense, we have an indication here that EA functional testing covers only the absolute basic conformance testing required for EA. The second issue relates to the operator's liability and exposure in supporting customer premises equipment that requires additional performance testing. In cases like this, the operator is faced with additional reputational and economic damages (should equipment impede network functionality) and would this be self-incentivised to ensure that all EC equipment on their network, not only meets but *exceeds* the functional requirements of the EA approval process.

With this in mind, OS5J suggests a two-tier approach for operators providing EC equipment for use on their network:

(a) Mandatory standards required by ICASA to be provided using a declaration of conformity mechanism
(b) Additional requirements to test additional functionality as required by the operators.

There was, however, one informant that disagreed with the popular view that the level of standards should be on par with international best practice. OB2G noted that minimum standards for developing countries should differ depending on the jurisdiction such standards were applied to. The goal should be to achieve universal service at the least possible cost to the consumer. International standards are set at a level that would add significant cost to the end product, making the product unaffordable to financially constrained consumers typically found in developing countries. OB2G noted that promoting broadband penetration is a key goal for many developing countries and wireless technologies are becoming increasingly important in delivering wireless broadband access. Cellular telephones are generally the most cost-effective device used by consumers in developing countries to access broadband services, and the price of these devices are significantly impacted by the EA process. International performance standards would invariably increase the base cost of cellular phones and would thus hamper broadband penetration in developing countries. OB2G did concede that there should be no compromise on the safety of the device and thus safety standards should be on par with international safety standards.

SD2M had a more pragmatic view and said:

> We think that we are Switzerland. Everything does not run like clockwork here in South Africa as it does in Switzerland. We have people with illegal electricity connections, high crime rates, high levels of joblessness and unemployment - so why are we insisting on test reports? We can make things much less bureaucratic.

ICASA does not possess the mechanism to verify test reports independently, SD2M therefore argues that it is pointless to set any standard, either at a high or low level. Further compounding this issue is that fact that South Africa is a relatively small EC equipment market. Larger manufacturers will not conduct tests, costing more than a hundred thousand rands, just for the SA market.

The level of performance of EC devices is driven by technology and not the regulator. The example of an entry-level cellular telephone was listed (OB2G). The features prevalent in most basic phones today far surpasses those of an entry-level phone a decade ago. Technology drives equipment manufacturers to innovate or risk losing market share. Mandatory performance standards via regulation would thus not drive innovation and lower costs as competition and market forces already fulfil this function.

Standards also support competition, as the EA framework is based on open, international standards. Since international standards are based on an open platform, EA ensures that equipment that conforms to these standards are technically acceptable to operate on any network where such standards are adopted (TLS3T). This means that a range of markets is open to the equipment supplier, thereby increasing EC equipment competition in that market.

TLS3T further explained the standards development process in the local environment. Standards are adopted in this environment via a balanced representation process (involving affected stakeholders such as manufacturers and the regulator) at a local level at SABS, where parties discuss and agree on standards. These standards can be either locally developed or adopted from internationally used standards. Standard experts, via consensus building, agree on the content of standards and the applicability to the country. Approval of the nation is then needed, via a public comment process. The standard is then approved as a national standard.

The principle of standards supporting competition is still relevant at a local level, except only when a locally developed standard is adopted by South Africa (TLS3T). This is a relatively rare occurrence and is allowed only in exceptional circumstances. An example would be the level of lightning protection required in South Africa, given South Africa's high incidence of lightning. In this case, a more stringent and locally developed surge limits were added to the generic safety standard for EC equipment. In any event, these modifications and deviations from international standards must be submitted to the World Trade Organisation for scrutiny as South Africa is a signatory to the WTO's technical barriers to trade agreement. The WTO publishes these standards to all member countries to comment upon, with a view to determine whether the standard represents a technical barrier to trade. If the WTO rules as such after receiving representation from member states, South Africa would be obliged to remove such a deviation from an international standard (TLS3T). Figure 26 provides a representation of the main themes relating to the level of standards for a developing country.

Figure 26: Level of standards for a developing country

5.15 South Africa's state of development and the perception of credibility and stability

ICASA seems to be well aware that the perception and reputation of ICASA and the EA process are very poor. There are long lead times and inefficiencies of the system, raised by most of the operators and suppliers. By not allowing for the self-declaration of certain EC equipment, some suppliers are of the view that ICASA has inadvertently deterred potential investors (SD2M, SM1E).

The EA regime does not create a perception of stability and credibility in the market. OR1A also noted that the stability of the process seems to be upset by specific technical queries, for which the regulator seems unable or unwilling to respond to. Operators then do not have an avenue to address queries competently with skilled staff at ICASA, creating an unstable approval environment. This is further compounded by conflicting technical responses that are sometimes received by the operators from different technical specialists at ICASA. This lack of conformity in responses impacts both the credibility and stability of the EA process (OR1A, OK3H).

The lack of distinct processes for EA also impacts the perception of credibility. SD2M highlighted an example of FCC test reports. ICASA sometimes accepts these reports and rejects them at other times, depending on the staff member evaluating the EA application. This subjective assessment of the technical requirements of the EA process creates uncertainty within the industry and in turn negatively impacts the credibility of the process as well.

5.16 Conclusion

This chapter explored the unique characteristics of a developing country when considering a future innovative approach to regulating EA. The overall data gathered shows that although there are several characteristics unique to a developing country, the generalisability of developing countries is not straight-forward. South Africa, in particular, was seen as having a mix of both first and third world infrastructure, This mix was considered advantageous in leveraging the experience of EA innovation implemented in first world countries.

Chapter Six: Applying innovation to EA

6.1 Introduction

The aim of this chapter is to provide data for the third and final research sub-question of this study:

> *How can an innovative theoretical approach be created that addresses the challenges of the current theoretical approach to regulating EA?*

This chapter builds on the data presented in the last two chapters and summarises possible solutions for developing an innovative approach to EA regulation, while bearing in mind both the developmental challenges faced by South Africa, as well as being wary of the pitfalls that highlight the perceived failure of the current approach. Concepts such as collaboration, trust and innovation introduced in the last chapter, are extended further in this chapter, by suggesting a two-fold approach to both technology and regulatory innovation. This chapter provides practical solutions to creating an innovative approach to EA regulation in a developing country, with data grounded in South Africa. Using this data, chapter seven explores a theoretical approach to regulation using the grounded theory method. The data presented in this section, in some cases elaborate on data presented previously in chapters four and five, although the core focus is innovation with regards to the EA process.

6.2 An innovative approach to addresses the challenges

The broad objectives of the EA process going forward to develop a new innovative approach to EA regulation as envisioned by the informants interviewed. Informants were unanimous that the objective of "Integrity" of the EA process must not change. The focus should be on what matters in the EA process, which is the essential technical requirements. These technical requirements should be at an international level and should not be "watered down". Collaboration should be a key item to leverage the existing resources available in the country. ICASA should tap into the real knowledge that exists in the country. Collaboration in terms of test facilities at both local and international levels are required (OB2G, OK3H, OH1M, SD2M, SM1E).

Policy decisions at governmental level are required to build capacity in understanding the entire value chain of the EA process from EC design to sale. The aim should not be to implement more regulations, but to understand the impact of the current regulations better. There should be fewer requirements in the EA value chain to ensure that the process is less cumbersome (TLS3T).

The focus should be on the EA process and not the EA regulations. The EA process must be cheaper and more efficient. A quicker time to market means more products meant greater revenue for the country through increased tax collection. Different funding models need to be considered to fund test facilities. An example would be public-private partnerships between government and industry to fund conformance testing (TLS2L).

OK3H & RS3R saw testing as a regressive move and advocated a self-managed solution that accepted verified test reports from accredited institutions. Local testing duplicated efforts, increased conformance costs and created additional barriers to entry. Money spent on test facilities could be better devoted to promoting local manufacturing (TLJ1H). Local manufacturing should be encouraged, as this has proven to be a major driver of growth in developing countries. These innovations would increase confidence in the EA process and would stimulate innovation and competition. Superior products in the market would be the result of such initiatives (OH1M, TLJ1H).

Automation would be an innovative way to increase productivity. Self-declaration, coupled with a local test facility as well as allowing exemptions would reduce the administrative workload relating to the EA process. Technology advancements such as cognitive radios using the unlicensed spectrum would create a self-regulating environment (Lemstra, 2008). The entire EA value chain is driven by the people embedded in the process, and upskilling of the individuals in the EA process would lead to substantial gains in the efficiency of the process. This upskilling process applies to people internal to ICASA as well as stakeholders external to the process. Internal efficiency gains can be realised via training and upskilling of ICASA staff. External stakeholders can be upskilled via a clear communication and instructions made available by the regulator to stakeholders. These instructions should be clearly and extensively articulated to guide people at different levels of skills in the EA process. The ICASA upskilling process should also include an understanding of all the different product development process from prototyping to manufacturing (OR1A).

ICASA should investigate a mechanism to allow exemptions of particular types of equipment, as this would support the focus of approving the essential requirements of equipment to assure confidence and stability in the process. The current EA workload leads to long delays and frustration with the system, which could be alleviated should ICASA be more selective on what equipment is required to be approved. Certain operators are the only parties affected by the EA process, hence they are self-motivated to ensure compliance with the standards. This allows the regulator a degree of freedom in allowing equipment in these categories to be declared as competent for use by the network operator (OB2G).

A risk-based analysis should be applied to all equipment. The example of short-range infra-red equipment highlights the approach of the current EA environment, where the time, costs and process for certifying such a relatively innocuous device is the same as that for approving a 100kW Radio transmitter that has a range of several kilometres. A risk matrix categorising high volume low-risk equipment should be developed, with a view to differentiate or exempt such devices from the current EA process. Careful thought would need to be applied in this area, as the cumulative effect of interference caused by large volumes of low powered devices would also have to be considered (OK3H).

EA would always be a legal requirement. This is a core function that has to remain. It would be a much more efficient process that should not be considered as a regulatory hurdle. EA would contribute to the economy by enabling innovation and would no longer be a bottleneck or deterrent (PP1L).

Innovation is a major factor driving a future EA framework. Technology cannot be predicted, and advancements in innovation are very rapid. Technology can be disruptive to the market (the example of Over the Top (OTT) technology was cited in the cellular market), and this benefits the consumer. Technology can render major telecommunications players moot (OH1M). Product innovation would ultimately benefit the consumer. The key mandate of developing an innovative EA approach would be to ensure that such an approach does not inhibit technology innovation. Innovation can in itself solve many public interest governmental objectives without direct regulatory or policy interventions.

Any regulatory approach suggested should drive innovation and enable trade. Relaxing command and control would be an option - a more relaxed approach coupled with a strong enforcement regime (RM1K). This regime should prescribe severe consequences for non-compliance. Conversely, a "relaxed" EA regime was thought to provide more control for the regulator than a command and control regime.

Any approach suggested by the regulator would require a phased-in approach to engage with stakeholders in the EA industry. The sector is of vital importance to the economy of South Africa, and ICASA should be tentative in ensuring that any changes to the EA approach are well understood with as many negative scenarios mitigated before roll out (OK3H). Any new approach to EA should be focussed on maximising technical and administrative efficiency, although the effectiveness of the EA process should not be related to time as the only determinant factor. Quality of the EA process is paramount, with ICASA suggesting confidence in the EA process as one of its principal objectives (RN2A, RG5N, RM1K).

Increasing administrative efficiency by using an automated system to manage the EA approval process was seen as a quick win, and being the only real requirement to improve the system by many commentators. Efficiency was clearly related to costs, especially by equipment suppliers.

The focus on the type of standard (in terms of design or output standard) was not clearly determined. The proposed route of using international standards inhibits, to an extent, the ability of the regulator to choose the type of standards required for an innovative framework for EA in South Africa. The standards currently employed are a mix of design and output standards, as the design standards general describe the functioning of the equipment while the output standards describe the EMC and safety aspect of the device. The decision to maintain standards at an international level means that the earlier mix would still be applicable going forward as well.

There was limited support for South Africa to move to a liberalised EA regime such as those in Europe, where self-declaration is the norm. The rationale for such an approach was:

i. to decrease volumes of applications to ICASA, thereby reducing the administrative backlog
ii. Decrease the processing time of EA applications, leading to a quicker time to market

6.3 South Africa's developmental state and innovation in the context of EA

Several actors interviewed did not believe that that the current EA regime drove innovation. This seemed to be particularly true for South Africa's developmental state, where although it was felt that there are people who are great innovators, they are unable to get their product to the market due to regulatory hurdles. In this context, the current EA regulatory environment was seen as a barrier to innovation rather than a driver of innovation.

OZ4P provided an apt definition of innovation in the context of EA approvals as:
"Innovation is understanding the objectives what the markets and industry need and supporting this need through regulation". (OZ4P).

This statement is premised on first understanding the requirements of the markets and the EC industry first, before trying to apply a regulatory framework to support innovation.

Other commentators did not see any impact that the EA environment had on innovation. OH1M & OS5J were of the opinion that innovation exists naturally in South Africa and the EA framework has little to no impact on either driving or inhibiting innovation.

RN9B, however, was of the view the EA process inhibited innovation, especially in a developing country. The EA process requires test reports from accredited test facilities for all products, locally produced or internationally imported. This requirement means that locally developed EC equipment would require testing to international standards. Such testing may not be available in South Africa, due to a lack of testing facilities and the costs associated with such testing. This in turn obliges the local manufacturer to test his product internationally, which increases the overall cost of the product and immediately puts the manufacturer at a disadvantage, even before he enters the highly competitive EC equipment market. Local manufacturers are thus not incentivised to innovate and develop new products, and RN9B was of the opinion that the current EA framework was thus inflexible as it did not differentiate between local manufacturing and international imports.

RN9B further stated that innovation in terms of the EA process itself could simply entail automation. The current process was described as largely manual, and automation would result in significant gains in terms of processing time and human resource loads. A paperless environment was also noted as a key innovative feature, as the current system is dependent on large volumes of printed test reports and ICASA no longer has the capacity to store the large amounts of documentation related to each approval. This in turn leads to search and retrieval difficulties as some documents are being stored off-site.

OK3H noted that innovation need not entail South Africa developing unique solutions to the problems of the EA framework as adopting policies from other countries could be regarded as innovation. South Africa is not truly a developing country, as our infrastructure can compare to first world standards. Innovation of the EA process, using lessons learnt from other jurisdictions could easily constitute as innovation in the EA environment.

SN4M felt that the fact that we are a developing country actually increases our scope for innovation. By collaborating with various partners such as network operators, equipment vendors are able to extract more revenue from their product line as these operators are in some cases international organisations. There is an issue of trust here, as the equipment supplier has to fully commit to research and development with a network operator, with a view of mutual economic benefit to both parties. Such research and development may entail the equipment supplier sharing proprietary technology skills and knowledge with the operator, in order to test and develop technology with the ultimate goal of driving sales of such equipment. The operator gains by having access to the latest generation of equipment on their network, which generally equates to better service at lower costs to their subscribers. This mutual trust can potentially be a win-win scenario for both the equipment supplier and network operator, whilst simultaneously driving innovation in the sector:

> Sharing with partners is what helps drive innovation, e.g. The Vodafone group is rolling out technology in SA that they have in other first world regions such as the UK. These partnerships are global in nature and drive innovation, as equipment companies try to roll out the latest technology worldwide to lower equipment prices through economies of scale. We are not a standalone region, given the type of market that we have. Even as an equipment supplier, we partner with other regions to drive the latest technologies. This pushes SA companies to their limit of technology and is a very positive spin-off. (SN4M).

6.4 Collaboration among the various EA stakeholders to drive innovation

Collaboration with other test facilities was seen as a proposal to innovate the EA process, but the key point would be that the regulator was regarded as the key party still responsible for overseeing the entire process. Testing laboratories could conduct tests on behalf of ICASA and verify the test reports. Handing this function over to a third party would increase both technical and administrative efficiency. The test laboratory would also issue the certificate on behalf of ICASA. (PP1L, RN2A, RM1K, SM1E). ICASA would then audit the test laboratories to ensure the integrity of the process. The may even not be a need for testing should the test laboratory verify the authenticity of a submitted test report, and there would need to be mutual recognition agreements between the test laboratories to support this. The rigour in this process cannot be compromised as this would, in turn, compromise the quality of the device. There exists enough infrastructure in South Africa to leverage on existing facilities, without the need to build new facilities from scratch (TLS3T, TLS2L). The major disadvantage of this approach is the fact that the current test facilities in South Africa lack the ability to conduct the full suite of tests for EC equipment (RD3M). This would require significant investment from the test facilities for them to be able to conduct the necessary types of tests, hence collaboration between test facilities is needed to ensure that the full suite of testing is divided amongst them based on their ability and capacity (TLS2L).

It was also understood that confidence in such a collaboration process would improve over time, leading to administrative efficiencies later in the process. The added benefit of such collaboration using test laboratories is that they would also allow the regulator to circumvent the ‘golden sample’ problem, as the set up to test future products capacitates the test facility with the ability to provide verification of past test reports (TLS3T). This has the benefit of once again increasing the level of confidence of the EA ecosystem with the added benefit of increased consumer protection. The net result would be that such a program would enhance competition, although confidentiality and transparency of the process would need to be carefully managed by the regulator.

Collaboration between ICASA and SARS was seen as a critical process and one that should form part of an innovative future approach to EA regulation (OR1A). As SARS manages all border ports of entry into South Africa, they are the primary agency responsible for ensuring that no counterfeit or illegal equipment enters the country. The Customs and Excise Department within SARS should have up to date access to ICASA's EA database to have up to date information on EA approved products. Customs and Excise could be trained to differentiate between illegal counterfeit EC equipment and legal ICASA approved equipment. Equipment suppliers may have to be involved in this collaboration to assist with the identification.

In the same vein as cooperation with SARS, ICASA should develop some collaboration with the NRCS (TLS2L). The NCRS regularly conducts market surveillance at the airports, harbours and other ports of entry to check compliance of EC equipment for electrical safety. It would not be burdensome for them to check for ICASA approval at the same time and would also be preventing a duplication of resources regarding surveillance. Collaboration with the NRCS would result in ICASA being more proactive in terms of market surveillance. ICASA could reciprocate also checking electrical safety compliance of EC equipment during their own market surveillance campaigns, further enhancing the overall enforcement of the EC equipment market.

The above process would be driven by the current standards process, with internationally developed standards that conform to first world levels (RM4J). This would be implemented with a view to saving costs associated with testing to a unique, country-specific standards and would leverage on the economies of scale associated with the widespread adoption of a particular international standard.

Collaboration between suppliers was also seen as an innovative way to approach the regulation of EA (SN4M). EA should not be considered a competitive advantage between vendors. EA should be viewed as a shared task that allowed suppliers to work together to prevent a duplication of the EA process. In this way, a single application between several suppliers would result in a quicker approval for all vendors, prevent duplication, reducing time to market and reducing costs for all suppliers involved. ICASA would be central to facilitate such collaboration and should make an equipment database accessible to the public.

6.5 Considering a limitation of the scope of the EA process

An example of innovation cited was limiting the categories of equipment that require type approval (RM4J, RQ7L). It was considered not necessary to type approve all the equipment as defined by the broad ambit of the ECA. Some of the short range equipment, discussed earlier, using infra-red and having a very low probability of interference, was listed as an example. Based on power levels and EMC, ICASA could easily exempt such equipment from type approval without much concern for possible interference effects. The current EA regulations span equipment from 8.3 kHz to 6 GHz as requiring EA approval, which spans most of the usable spectrum bands. Another category of EC equipment that could be considered for exemption would be battery powered devices. Hand-held battery powered equipment could be considered as low-risk devices with a small probability of causing harmful interference. Mains powered devices are currently treated in the same manner as Hand-held battery-powered devices, even though the potential for causing interference and electrical shock to the user is vastly different. Exemptions are seen as the first step to streamlining the process. High levels of innovation are driving the multiple product cycles throughout the year, and EA can become a stumbling block if ICASA considered all equipment as requiring approval. ICASA would need to develop guidelines that define categories of equipment based on electrical power consumption and frequency use that could be exempted from the EA process (RM4J).

A simple process was seen as the most innovative one, as the “time is money” concept would serve as the basis for innovation. A quicker, simpler EA process that incorporates exemptions would save manufacturers valuable time, decreasing their compliance costs and making their processes more efficient (SN4M). This saving would, in turn, be passed onto the consumers, which results in a positive knock-on effect on the entire EA value chain. A simplified EA process would also lead to administrative efficiencies within the regulator itself, requiring fewer resources and thus cost for the management of the EA process. Savings could be used to strengthen post-market surveillance, ensuring that emphasis of the EA process remains with its public interest objectives.

6.6 Challenges to implementing an innovative EA framework

ICASA does not have test facilities to independently verify test reports sent to the regulator in support of an EA application. In this case, without implementing any further action- the regulator would have to consider instances where test declarations are accepted fully without the actual test report. This once again leads to the theme of trust between the manufacturer and the regulator, but given that the regulator does not have a mechanism for verification, it would be prudent to examine possibilities of accepting test declarations (OS5J).

6.7 Mutual Recognition Agreements (MRAs) in the EA environment

ICASA has been advised to enter into both regional and international MRA's. MRA's were seen as a mechanism to streamline the EA process and ensure a quicker time to market for EC equipment (ITU, 2014). The requirements for the EA process would not change, but duplication of the EA process would be prevented. An MRA would assume that the technical considerations for EA approval between both countries are harmonised, and can then leverage the resources of both countries to ensure that the requirements for EA approval are met. Such harmonisation, however, can be difficult to achieve given that different countries have different requirements based on their national frequency allocation (RS3R). The ITU, therefore, suggests that like-minded authorities from developing countries develop a framework for harmonisation and agree on areas of cooperation to promote harmonisation (ITU, 2016:11). RS3R notes that although mutual recognition agreements are necessary, technology itself prevents worldwide harmonisation. Country-specific requirements are thus unavoidable, although, in terms of technical barriers, MRAs between countries within the same radio region would still be a relatively straightforward proposition.

The financial considerations for both the EC equipment supplier and the country to which EA is applied for can be significant should MRAs be permitted. Suppliers would have quicker access to market and lower costs of compliance, which could ultimately lead to lower product costs. The EC market in which the product is being sold would have access to the latest equipment and competitive prices, stimulating the EC market through increased sales (OH1M).

Even without a formal mutual recognition agreement in place, countries like Botswana already accept ICASA type approval certification without any further local approval (SD2M). South Africa was considered a leader in the African continent in terms of technology adoption and technology development (SN4M). South Africa had significant resources regarding access to information, especially since all the key EC manufacturers have a presence in the country. This ensures that South Africa can leverage such information and position itself as the gateway to Africa regarding EA approval. The major manufacturers would use their already established presence here to launch products throughout Africa, especially if South Africa entered in MRA's with other countries. South Africa would thus benefit, rather than be disadvantaged by entering into MRA's with its neighbours.

6.8 Encouraging flexibility in interpretation of the current regulatory framework

ICASA is seen as inflexible when it comes to interpreting the current EA regulation. A more consistent and pragmatic approach to interpretation would not require any "innovation" on the part of the regulator, aside from being innovative in considering differing interpretations of current regulation (OS5J). As an example, ICASA was asked to be more pragmatic in terms of labelling equipment, with a specific focus on the size and type of device. For suppliers and operators to open boxes and affix ICASA labels onto devices to show compliance to the EA regulations, voids any warranty unless the labels were specifically pasted at the point of manufacture (SM1E, SD2M). Although this does occur, there are instances when the point of labelling happens when the equipment arrives in the country. ICASA could investigate other options to ensure that the regulations are followed, without voiding the warranty of the device. The same applies to very large or very small network equipment, where it is unfeasible to affix an ICASA label onto the equipment. The e-labelling initiative by ICASA was seen as a positive step in this regard, where a software application on the device can be run to display the regulatory information about the approved device.

OK3H concurred with the view that there is no need to change the regulatory framework that governs the EA process as all that was required was some flexibility in interpretation. Technology has meant that transactions worldwide are occurring in real time. Customers shop 24/7/365 in real time. The EA process has to embrace technology and moving away from a physical-based approach to a time-based approach to prevent delays and bottlenecks within the EC equipment market value chain. Delays in one link of the chain invariably impact the consumer layer of the market. EC equipment should be considered as fast moving consumer goods that are very sensitive to the time to market.

6.9 The Review period for standards and regulations

The review period of the regulatory framework for EA was found to be problematic. The Official List regulation is almost a decade old but was noted as being updated only twice in that period. The cycle of updates is not quick enough to follow the changing standards (OS5J) and issues of regulations being inflexible in its ability to be able to keep up with technology are once again made. Future innovative EA regulation must be flexible enough to allow the use of the latest standard, without specifying a standard name. SN4M cautions that any change to the EA process would need to be incremental in nature, as such changes would impact the equipment supplier the most.

6.10 EA fostering 5G and future broadband technologies

The future 5G mobile broadband spectrum use will depend on a coordinate use of these frequencies. EA was seen as a critical instrument in frequency coordination for devices operating in the 5G frequency bands (OZ4P). 5G would usher in a multitude of devices that may be an order of magnitude greater than what is currently used today. This explosion would be mainly due to the prevalence of machine to machine communications, exposing all users of EC equipment to the risk of interference. A robust, innovative EA approach would need to ensure that the safety, performance and emission parameters of all EC devices are met, irrespective of the volumes of future devices that will be made available to the market. In essence, the future EA framework must be independent of volume but still cognisant to the essential requirements.

In the same vein as future 5G technology, shared access technology such as Wi-Fi would continue to play a dominant role in facilitating broadband access. RS3R notes that sharing of frequency bands would become more critical, given the increase in the number of connected devices. A future EA framework would thus have to place greater emphasis on frequency sharing and harmonisation. RS3R states that South Africa should continue following the European example of a 100mW output power for Wi-Fi devices, as it allows for the higher reuse of the frequencies. In comparison, the US allows 1W output power for Wi-Fi, and the net results are that the reuse of frequencies is poor. The entire band becomes overused, and this leads to the eventual degradation of the whole Wi-Fi band, rendering it unusable. A future EA regime should value band sharing above coverage and range considerations, and thus should resist any attempts to increase the power of the Wi-Fi band. Europe has conducted several studies that show that the lower power ultimately yields higher efficiencies for the use of shared bands.

6.11 Outsourcing the EA function

An innovative solution to addressing the issues of volume as well as capacity related to outsourcing the EA function to accredited test laboratories (OZ4P). This approach is similar to the FCC approach of designating Conformity Assessment Bodies. This takes the concept of collaboration with test facilities a step further, by empowering them to grant EA approvals on behalf of the regulator. This innovative approach has the added benefit of addressing the ‘differentiation of suppliers’ theme, as all providers would be treated in the same way. It has the advantage of decentralising the EA approval process, removing the issues of administrative volumes and associated delays. No further information was provided regarding the specifics of deploying such a solution, leaving the details to be developed by the regulator.

Another suggestion was to outsource the EA function entirely to an independent third party (RM4J). There has been a precedent for such an initiative, with ICASA delegating the function of managing number portability to the Number Portability Company, which is co-owned by the cellular operators. The responsibility of the EA function itself would remain with the regulator, as only the management of the process would be delegated to maximise administrative efficiencies.

6.12 Preventing a duplication of the EA process

RD3M noted that EC equipment approved in the EU form a large percentage of the equipment submitted for EA approval in South Africa. Such equipment has a compliance number or identification number that can be verified by ICASA, with limited technical and administrative burden to ICASA. Accepting such approvals without further technical or administrative checks would greatly streamline and prevent duplication of the EA process. The ECA already makes provision for this and thus removes any legal impediments. Claims of the EA process simply being a “rubber-stamping” exercise would also be laid to rest, as well as the assertion from certain commentators that the EA process is a rent-seeking exercise by the regulator.

OK3H suggested adopting the banking sector approach using technology to assist with verification. ICASA should employ a smart solution that regularly updates a central database of approvals from various approval bodies. Inspectors could use a scanning device that automatically checks the equipment to this database. If approved elsewhere, there should be no further EA requirements imposed on the device locally. EC equipment can be scanned to check a database of previous approvals. There would be no need to duplicate the EA process locally as one could simply use the European level approval and scan equipment to ensure that the equipment is safe to use. This relates to the solution of collaboration with other regulatory approval bodies and will make sure that the workload of the regulator is substantially decreased as well (SN4M). This approach would be useful especially at the customs and border posts of entry. The current physical paper certificate ages and becomes illegible. An electronic copy was all that is required and can be easily shared (RS3R, SN4M, SM1E).

6.13 Globalisation and consumer protection

OK3H made the somewhat contentious point about the future of the EC market. Globalisation of EC equipment has led to equipment manufacturers becoming global distributors of equipment. Consumers regularly buy equipment overseas with the tacit knowledge that they will not receive any local support or guarantee for the product. Economic considerations regarding a favourable price outweigh the potential consumer protection deficiencies, and the customer knowingly purchases EC equipment abroad. Some manufacturers offer worldwide guarantees for their products, making local regulations aimed at consumer protection moot. An innovative EA framework would thus need to consider the effect of globalisation of EC equipment to the changing consumer protection landscape.

Chapter 7: Towards a grounded theory of an Innovative approach to EA in a developing country

7.1 Key concepts emergent from the data - Initial coding and selective coding processes

An emergent grounded theory of the EA environment in a developing country was advanced through the systematic adherence to the grounded theory method described in chapter three.

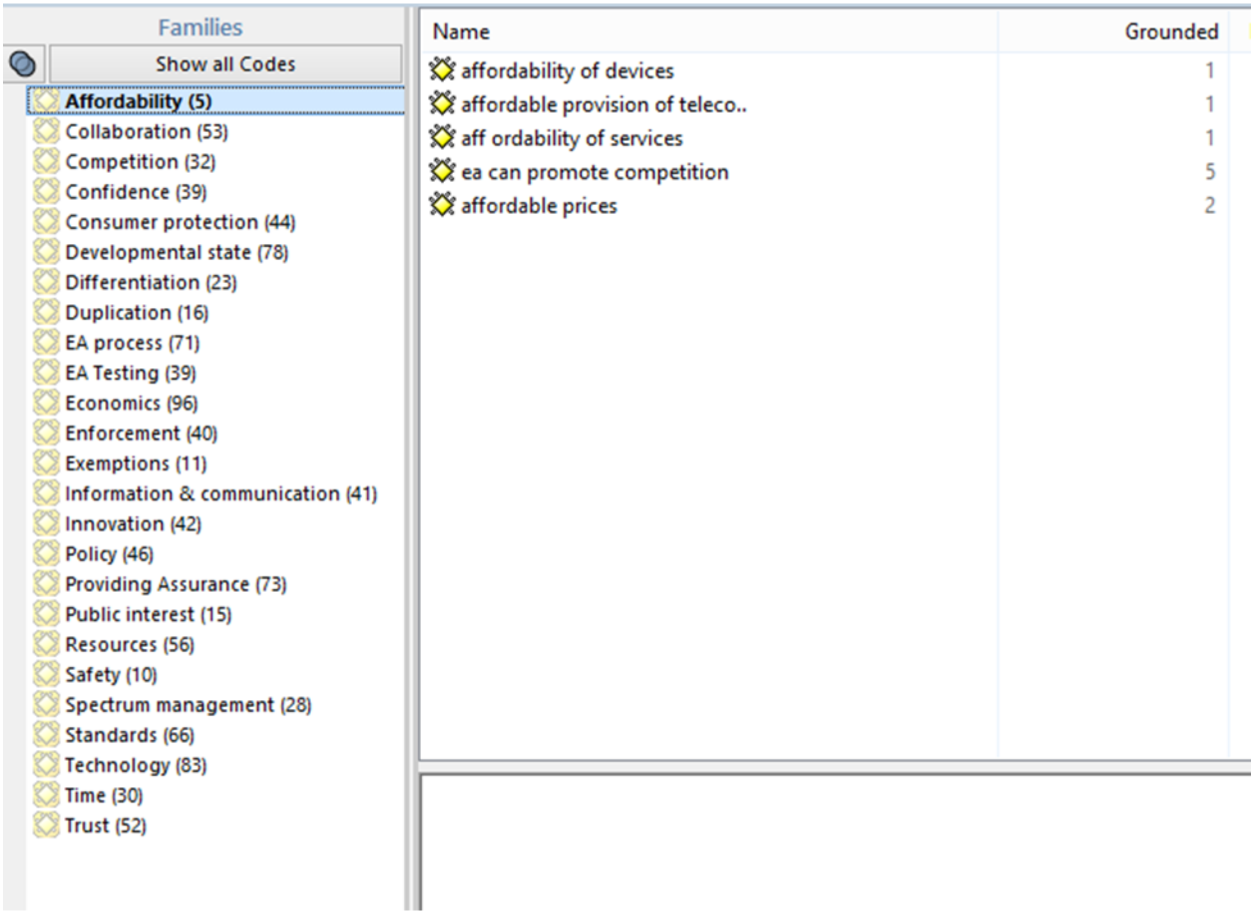
I. Codes

The first step of the process was to code the various data sources. The process of coding assists the researcher in sorting out the data and assigning a name to a particular category of data. In all, 2507 total codes and 939 unique codes were generated during this study. The complete list of these codes can be found in Appendix F. These codes were generated by breaking down the data gathered into individual ideas and concepts.

II. Code-families

The second step of the process involved selective and focused coding, whereby a more selective and conceptual approach to coding is adopted. Using the already developed codes from the initial coding process, the adequacy of these codes were tested using the philosophical framework adopted in chapter three, leading to codes that were more analytical and that categorised the data more completely. Focused coding reduced the 939 distinct codes to 24 code-families. The approach adopted involved ensuring that duplications of codes were removed, where each code representing similar concepts that were captured by coding that essentially conveyed the same idea, but differed in the text used. The code-families developed were more directed, selective and conceptual as well as being grounded in the data. The Atlas.Ti program manages the process of code families by linking various codes to a code-family. The process entailed analysing the data again, to code data in respect of the main themes, using an analytical purview not previously considered (Charmaz, 2006:59). Figure 27 depicts the process of selective coding into code-families.

Figure 27: The code families



III. Memos

The next step in the grounded theory process involves writing memos. The memos contained here are the advanced memos, derived from interrogating the codes and defining the analytical properties subsumed by these codes to develop key categories. At times, raw data from the interviews have been brought into the memo to support the analytical claims being made, but the majority of associated data is stored and referenced by the QDA program used. These memos represent a level of abstraction of the data, and it is presented as part of the major themes or key categories developed in the analysis phase.

IV. Key categories

The key categories are developed through a conceptual rendering of the code-families. The key categories and related data are further analysed using inductive reasoning to develop the substantive theory.

7.2 Determining the key categories

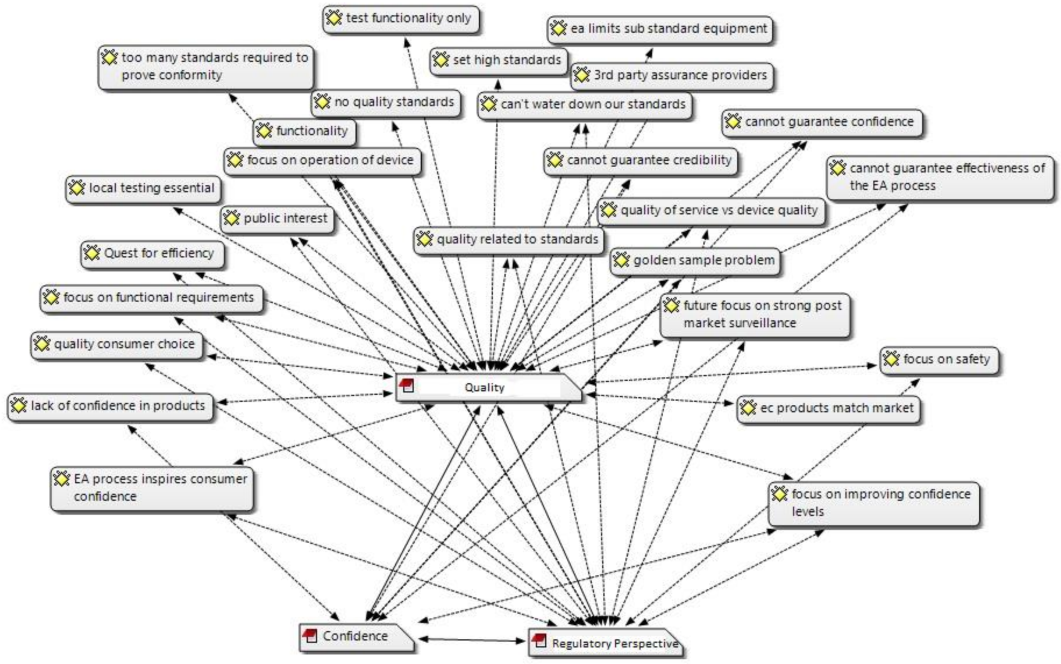
The grounded theory method of constant comparisons is also adopted, with comparisons between data and data, data and codes, codes and codes, codes and categories, categories and categories being made. Such analysis enables these categories to coalesce, and more theoretical levels of abstraction are built directly from the data. The iterative constant comparison method is the cornerstone of the grounded theory method, and it aids in advancing theory development during each step of the data analysis phase (Charmaz, 2006). Several network diagrams (that follow in the next section) are incorporated into the data analysis, as a diagrammatic representation is ideal in depicting the various relationships between different codes, memos and texts. To simplify the diagrams, the links between the categories and the actual supporting data segments are not included. The Atlas.Ti program can show all data segments associated with every code and memo in the study and this functionality assists the researcher greatly with tracing the source data.

The key categories are discussed next.

7.2.1 Design for manufacturability

Figure 28 depicts the properties and dimensions of the key category “Design for manufacturability”. The code-family of “Quality” is at the centre of this category. Applying the constant comparison technique of grounded theory across codes shows that the code-family of “Quality” is related to the code-families of “Confidence” and the “Regulatory perspective” as well. These codes will be discussed in greater detail in subsequent sections of this chapter.

Figure 28: Properties and dimensions of the key category "Design for manufacturability".



Quality is a code-family that arises from the data analysed and relates to the envisaged end-product of the EA process, where EC equipment subjected to the EA process is perceived to be of high quality. The data suggest that the EA process ultimately enforces the functionality of the equipment, not the quality. The assessment of quality is in itself a subjective process. There is a lack of focus on quality built into the EA process. The functionality of EC equipment relates only to the safety, interoperability and EMC characteristics. EA thus regulates only the minimum requirements relating to the functionality of the EC equipment. The EA process is aimed at creating consumer confidence only regarding the basic functional requirements and does not guarantee confidence regarding the quality of the equipment. The data analysed shows that quality is a function of consumer choice, i.e. the consumer makes conscience decisions regarding the quality of EC equipment purchased based on the price of the equipment. Customers expect high quality for higher priced EC equipment but would accept lower quality equipment at a lower price. The developing country environment also determines the price at which EC equipment can be sold and ultimately price, not quality is the overriding factor in EC equipment purchases.

Manufacturers apply the principle of "Design for manufacturability", where equipment manufacturer is proactively optimised in terms of manufacturing, fabrication, testing, procurement, shipping, delivery, service and repair (Anderson, 2004). The function of the design for manufacturability process is intended to ensure that an appropriate balance between cost and quality is achieved. Safety and regulatory compliance are further noted as key determinants of the "design for manufacturability" process. The EA process, being a regulatory compliance exercise, is thus an important consideration in the design process for EC equipment. EC equipment is therefore designed to the mandated regulatory standards specifications. Cost and quality of the equipment are distinctly separate determinants of the "design for manufacturability" approach. "Design for manufacturability" is thus the first key category identified in the data analysis process. This category highlights the emphasis on functionality that is attributed to the EA process.

The focus on functionality from an economic perspective was regarded as the correct approach based on the data analysed, as applying further quality standards to EC equipment would result in the net cost of the equipment increasing.

Memo 1 describes the key category of "Design for manufacturability".

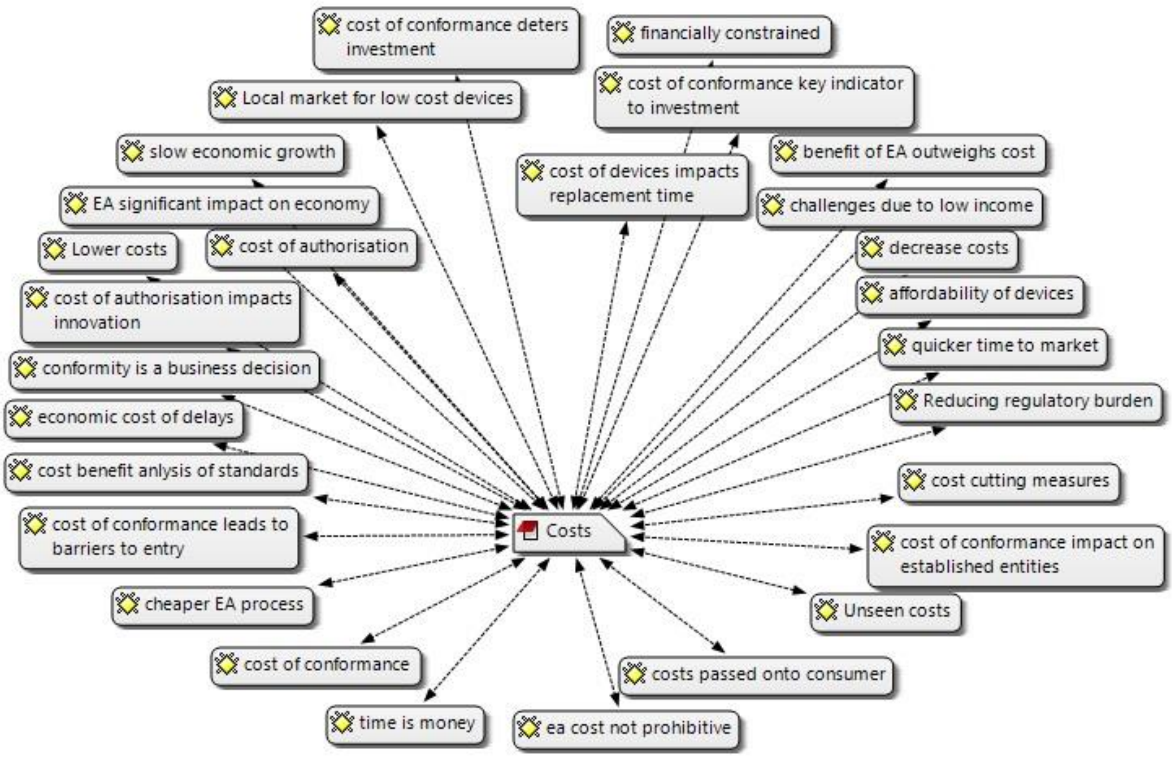
Memo 1: Design for manufacturability

The purpose of EA approval centres on functional requirements. The question of whether the current EA process facilitates quality is not easily answered. The EA process ensures the interoperability and operability of EC equipment, but would not necessarily lead to a quality product. This raises the question of the extent to which consumer interest is being advanced via the EA process if only the rudimental functional requirements are tested. The implication is that only a rudimental level of quality can be guaranteed via the EA process. This implication leads back to the focus of EA. The current EA approach ensures network operability and interoperability but does little to ensure quality. EC equipment is "designed for manufacturability" from the outset, with a specific focus on the cost of the equipment. Functional requirements are key to the design, as is the ease of regulatory conformance.

7.2.2 Costs

Figure 29 represents the properties and dimensions of the key category of "Cost".

Figure 29: Properties and dimensions of the key category "Costs"



The code-family of "costs" is at the centre of this key-category. It is immediately evident that the code-family of "cost", while cited numerously during the open-coding process, is not related to adjacent code-families. A clear indication of a multidimensional construct would have been visible in Figure 29, where an analysis of the data regarding the code of "costs" would subsume other code-families, indicated visually by arrows linking "costs" to these codes. "Costs" is certainly an important code analysed in this study, but appears to be superficial and self-contained. Analysing the relational statements to the code of "costs" shows that "costs" is an impacting variable on several code-families, but does not form a definitive construct in terms of the over-arching theoretical categories analysed in this study. As an example, "costs" was noted in the data to contribute to delays in the EA process and was coded as the "economic costs of delays". "Costs" on its own however was not cited as a factor that caused delays to the EA process. It should be noted that only variables impacting the costs related to the EA process were considered as other costs exist in the EC equipment value chain.

This is a surprising finding, given that the study is grounded in a developing country environment,where economic considerations formed an integral part of the initial literature survey. The data, therefore, suggest that the economic theory of regulation, although applicable to this environment, is not a key determinant of the core theoretical underpinning of EA regulation in a developing country. The evidence further points that the developing country status of South Africa has little to no impact on EA costs. Labour costs were a particular example cited in the study, where the relatively low labour rates in South Africa was seen as facilitating the EA process rather than hindering it.

The data points to "costs" as a code-family that can have a significant impact on the success of an EA regime but does not contribute to a theoretical approach to a future EA regime. Evidence from the data gathered, in fact, suggests that manufacturers value the EA process and do not mind the associated costs related to EA approval. The confidence that an EA label instils in the customer is valuable, and manufacturers accept the cost related to generating such confidence. The economic costs of delays are a larger source of concern to the EA suppliers and thus the code of "time is money" as adopted in a commercial environment, was noted as a principle that is not well appreciated by the regulator. The key-category of "cost" will be subjected to further theoretical sampling before a decision is made on including it in developing the final substantive theory.

Memo 2 reflects on the importance of the key category of "Costs".

Memo 2: Costs

It was not evident amongst the interviewees that the costs related to the EA process are a stumbling block to the success of EA. There is a tacit acceptance that costs cannot be entirely reduced in this environment, but that the current costs are high and may serve as a barrier to market entry. The antithesis to this is the manufacturers do not mind the testing and conformance costs, as it serves to protect them and instils consumer confidence. EC equipment suppliers vertically integrate conformance costs into the cost management structure.

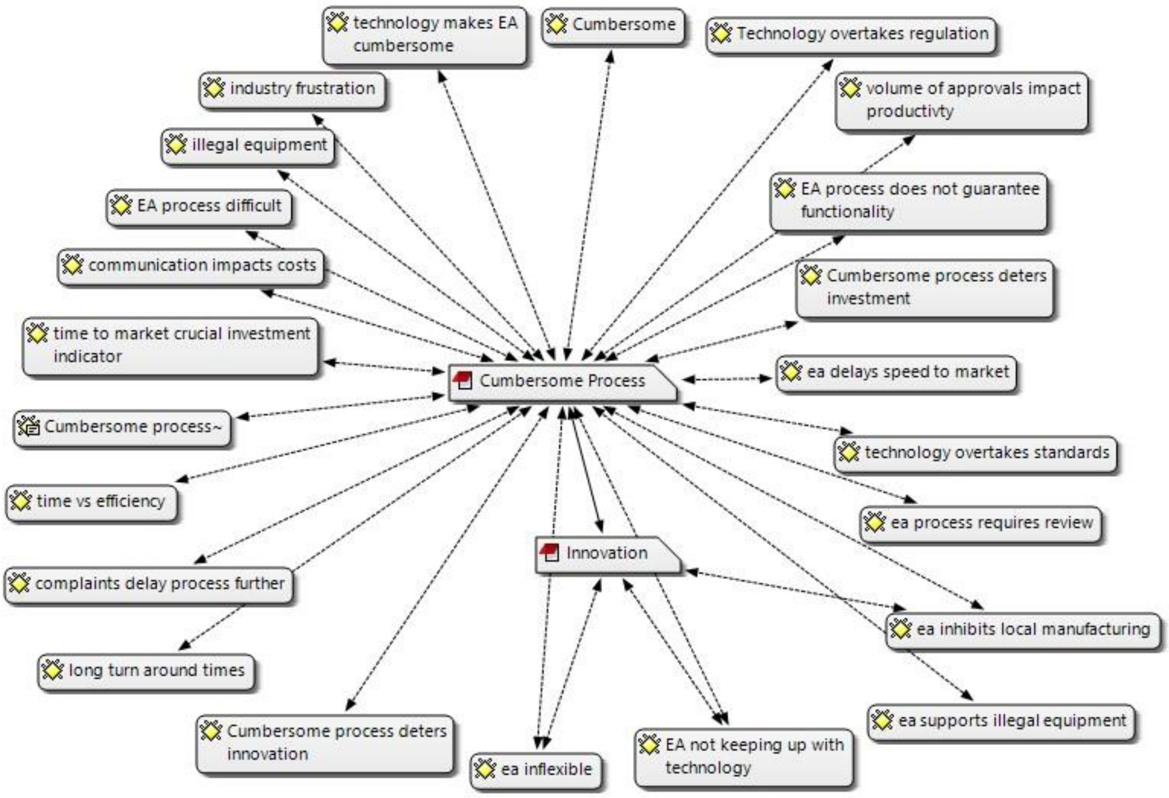
Two developments seem to have co-occurred. The first is that the number of EA tests required per device has increased substantially, increasing the overall cost of testing. At the same time, however, the costs related to each test has decreased due to newer test technologies such as digital equipment as well as automation in the process. Another issue raised was that labour costs do not form a significant percentage of the EC equipment cost, hence South Africa as a developing country, with attractive labour rates, should not be at a disadvantage regarding labour costs. The overall net effect is that all expenses in the EC equipment environment is ultimately passed onto the consumer. EC market is driven by economies of scale, hence large volumes are required to drive profits. South Africa is a relatively small EC equipment market, and suppliers cannot request OEM's to conduct R100k tests just for the South African market. The cost of the EA process itself is not prohibitive, and the value of the process outweighs the cost.

Manufacturers and equipment suppliers have raised the issue of "time is money". Although the regulator claims to understand the financial impact of delays that the EA process causes to the suppliers, the suppliers themselves are of the opinion that ICASA does not fully understand the financial burden of such delays.

7.2.3 Transactional process determinants

Figure 30 is a network diagram that describes the nature of the EA process. The code-family of "cumbersome process" is at the centre of this category.

Figure 30: Properties and Dimensions of the "Transactional process determinants" key category.



The entire end-to-end EA transaction has been described as being "cumbersome" in several instances throughout the data. The term "transaction" is fitting, as it ultimately sums up the "time is money" code discussed earlier, where informants saw the EA process as a necessary business transaction.

The code-family of a "cumbersome process" is also linked to the code-family of "Innovation". The EA process was seen as a barrier to innovation and trade by equipment suppliers. A general lack of value-add was noted concerning the EA process as it was thought to be a duplication of international approvals, and such a duplication was a key determinant of the perception of the EA process as being cumbersome. As ICASA did not have the mechanism to test equipment themselves, EC suppliers saw no value in a desktop approval process. EC suppliers were primarily concerned with the time to market, where delays have a significant economic impact on them. The regulator’s inability to verify test reports for EA was surprisingly not a determinant in the EC equipment supplier’s trust in the regulator’s ability. Various transactional factors have impacted the EA process, although the prime focus seemed to be the efficiency of the process, which was characterised by constant delays, lack of communication and inflexibility.

The regulator, however, did not trust the authenticity and validity of international test reports (exogenous to the EA process) and looked for mechanisms to corroborate the information received from EC equipment suppliers. Other transactional determinants that exacerbated the cumbersome nature of the EA process was the regulator adopting a uniform approach to all EA applications, irrespective of the type of equipment being approved. A key category of “transactional process determinants” was thus noted.

Additionally, the EA transaction for EC equipment suppliers was uniform, irrespective of several trust and reputational determinants such as the supplier’s market share, previous application history and financial standing. Informants suggested that ICASA could consider these determinants as an opportunity to streamline the current EA process, by deviating from the mandated process in certain circumstances. It was thought that such deviations would decrease the administrative burden of the regulator and increase the efficiency of the EA process in general. This approach was in keeping with the theme of trust, where the regulator was willing to differentiate between suppliers, based on pre-defined criteria. This construct of “trust differentiation” will be discussed further later on in this chapter.

The public interest objectives of EA have already been documented in this research. The data, however, points to the current EA approach aiding in the proliferation of illegal and obsolete equipment. Consumer protection and consumer safety objectives, subsets of public interest theory, are undermined by the current EA regulatory approach. The current EA regulatory approach was seen as a catalyst for the illegal equipment market, as its complex and cumbersome nature made adherence to the regulations problematic. As a result, an illegal EC equipment market has flourished in South Africa. The long turnaround times for processing EA applications has also resulted in obsolete equipment being introduced to the South African market, which allows EC equipment suppliers to legally “dump” their obsolete EC equipment inventory into the country. The EA regulatory framework was intended to encourage innovation and ensure that South Africa has access to low-cost, cutting-edge technology EC equipment.

An innovative theoretical approach to EA regulation in a developing country must, therefore, ensure that the regulatory process itself is agile and incorporates elements of “transactional process determinants” when applying rules to suppliers. This concept must be applied both at the EC equipment level (where categories of equipment and potential to cause harm is defined) and the EC equipment supplier level (where pre-defined criteria must be considered that would determine the approval path for different suppliers). Such an approach would ensure that concerns such as illegal equipment and dumping of obsolete equipment would be largely neutralised. Memo 3 discusses the “transactional process determinants” of the current EA process as endorsed by the research informants.

Memo 3: The transactional process determinants of the EA process

ICASA is aware that the current EA process is not fit for purpose and may inhibit innovation and trade. ICASA does not believe that a faster time to process applications is related to an efficient EA transaction. Several determinants impact the perception of the EA transaction.

Network Operators saw the current process as a duplication of what is done in other jurisdictions and noted that ICASA does not have the facilities and/or ability to verify test reports independently. The validity of test reports is thus a key determinant of the EA transaction, although this process is seen as a paper-based exercise without much value, given the ICASA has to rely on a summary of the test report. ICASA has never declined an application that was tested to the appropriate standards, which indicates that the EA process essentially duplicates the international approval, or merely rubber-stamps approval for the South African market. There is no added value in technical conformity assessment. Also raised was the issue of trust, where ICASA has to trust the validity of the test report as it does not have an independent mechanism of verification. Trust is a key determinant of the EA process. The long lead times of the EA process has a direct economic implication to the supplier.

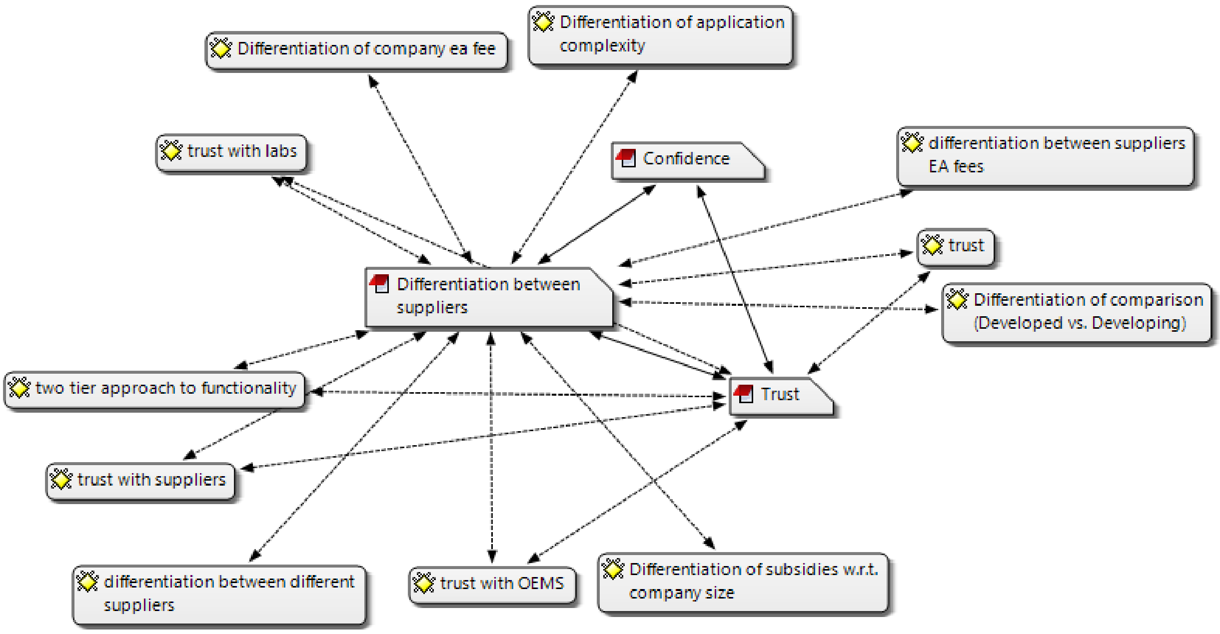
Another transactional determinant of the EA process is capacity. The human resource limitation faced by the regulator impacts the ability to communicate effectively with stakeholders. Stakeholders such as major equipment manufacturers will not ship equipment to a country without regulatory certainty, thus communication impacts EC equipment investment. Long processing times for EA applications leads to conflict between ICASA staff and EC equipment suppliers, exacerbated by limited human resource capacity and administrative inefficiency. There is no differentiation in EC products, as even battery powered equipment with a low probability of interference is treated in the same manner as other high-powered transmitting devices. This highlights the inflexibility of the EA regulatory framework in dealing with different types of EC equipment. The ability to cause harm is thus an important determinant of the EA transaction that is not catered for in the current regulatory approach.

The current EA process is not clearly defined and not well understood. Some equipment that should require approval is not being approved, such as elements that make up network equipment. The EA process may, in fact, support the proliferation of illegal equipment by the process being difficult to comply with. The long processing time can cause equipment to become obsolete before the equipment is released in South Africa. This opens up the possibility of manufacturers dumping obsolete equipment in South Africa. The EA process is thus a contributor to the problem of dumping.

7.2.4 Differential trust

Figure 31 details the properties and dimensions of the category "Differential trust".

Figure 31: Properties and dimensions of the key category "Differential trust".



“Differentiation of suppliers” was determined to be the central code-family. Applying inductive analysis to this key code yielded “differential trust” as a key category. The argument for “differential trust” is made after analysis of the data revealed a distinctive differentiation between EC suppliers. A two-tier “trust matrix” was suggested, with larger suppliers (who ostensibly value the effects of reputational damage more than smaller suppliers) to be considered “more trustworthy” than a smaller supplier. Original Equipment Manufacturers were cited as a prime example of a tier one (or large supplier) based on company size, reputational awareness market share. A tier two supplier (or small supplier) would be considered a reseller of various OEM EC equipment with no brand loyalty. Tier two suppliers would also be considered to have a smaller market share, infrequent EA applications with lower volumes and less exposure to the impact of reputational damage.

The code-family "Differentiation of suppliers“ was related to other code-families of “Confidence” and “Trust”. Once again, the underlying themes of organisational trust and confidence are evident from the data. The concept of "differential trust" can be explained as the level of trust assigned by the regulator to a supplier, based on the tier status and salience of that EC equipment supplier, with tier one suppliers enjoying a higher level of trust than tier two. Lyons (2013) proposes a similar model of differential trust across political institutions. The concept of "salience" or visibility was introduced in his study, where salient political organisations with high visibility to the public were trusted based on the basis of perceived political and economic performance. Salience is analogous to the reputational consideration of tier one OEMs, who can be considered to have higher visibility to the public than a tier two supplier, irrespective of the fact that the tier two supplier could be providing the same EC equipment as the OEM.

Tier two suppliers were seen to have difficulties in accessing test facilities and test reports and did not understand the EA requirements. The technical information proved especially problematic to tier two supplier, given their limited resources when compared to tier one suppliers. Adherence to the ICASA EA process, the provision of the correct technical documentation and the access to the appropriate test facilities were key determinants of trust for the regulator. Organisational trust theory states that:

> ...prior to their first encounter with another party, individuals tend to construct initial trust beliefs regarding that party. In the context of establishing a new inter-organisational relationship, the formation of preliminary trust beliefs is particularly relevant during the relationship initiation stage (Schilke & Cook, 2013).

The initial interaction between tier two suppliers and the regulator is thus a contributing factor to the regulator's preliminary trust belief towards tier two suppliers, further enforcing the "differential trust" concept. Tier one suppliers were noted to conduct their own, in-house testing – which further entrenches the notion of their results being trustworthy. These suppliers have also approached ICASA and the NRCS to enquire whether any of their products were ever the source of interference. The regulators have not been able to confirm this, which further ingrains the notion of trust with their products. By approaching the regulator and highlighting a positive track record, these suppliers have elevated the salience of their organisation, further engendering the primary trust relationship with the regulator. The analysis of the data, however, does not show conversely that the absence of salience lowers the level of confidence in that supplier as viewed by the regulator. The presence of salience only increases the levels of confidence.

Memo 4: Differential trust

There are common threads from various interviews that speak to a two-category supplier definition. There are the "major manufacturers” and the "small suppliers". Confidence levels and trust levels differ with these two types. Larger manufacturers and suppliers are happy and more easily able to conform to the current EA regulations. They have an overall positive outlook to the current EA framework, while it seems that the smaller manufacturers or suppliers do not view the EA framework in the same way. The majority of small suppliers find the process cumbersome and difficult to understand and comply with. ICASA is seen as having the responsibility to provide a level of support to the smaller suppliers, to assist them in understanding the EA process. There is support from all informants that a differentiation between suppliers is required and that the larger suppliers should be allowed a certain level of autonomy and trust, based on the risk to their reputational damage. A self-declaratory model is suggested for the larger suppliers.

There is now a reversal of roles, where previously network operators tested OEM devices on their networks to determine whether to allow such devices onto their network. Larger OEMs such as Apple now test their equipment on the operator network first, before agreeing to release their equipment to the operator’s network. The brand reputation is essential to larger OEMs, and they would not jeopardise their brand without first conducting network interoperability. For smaller operators, access to test facilities is a problem - especially in the case of developing countries where test facilities are not easily available.

A two-stage approach to suppliers is suggested with respect to operators:
1. Mandatory standards required by ICASA for Tier One suppliers.
2. Additional requirements to test additional functionality for Tier Two suppliers.

Tier One suppliers will not purchase equipment without the proper ICASA equipment authorisation. The value of the ICASA brand is growing. Larger suppliers conduct their own in-house testing, much like the network operators and have approached ICASA and the NRCS to determine whether any of their products have ever caused interference. The regulators have not responded, either because they do not have any evidence or are not able to access such information easily.

ICASA thus applies a “differential trust” approach, with OEMs listed at the highest level of trust based on their exposure to reputational damage. The regulator understands the danger in adopting this approach - it would favour Tier One suppliers as Tier Two supplier would not have the financial ability to meet the additional standards set out by the regulator. This would further entrench the larger operator’s market share and negatively impact competition in the market.

7.2.5 Technology assimilation

Figure 32: Properties and dimensions of the key category "Technology assimilation".

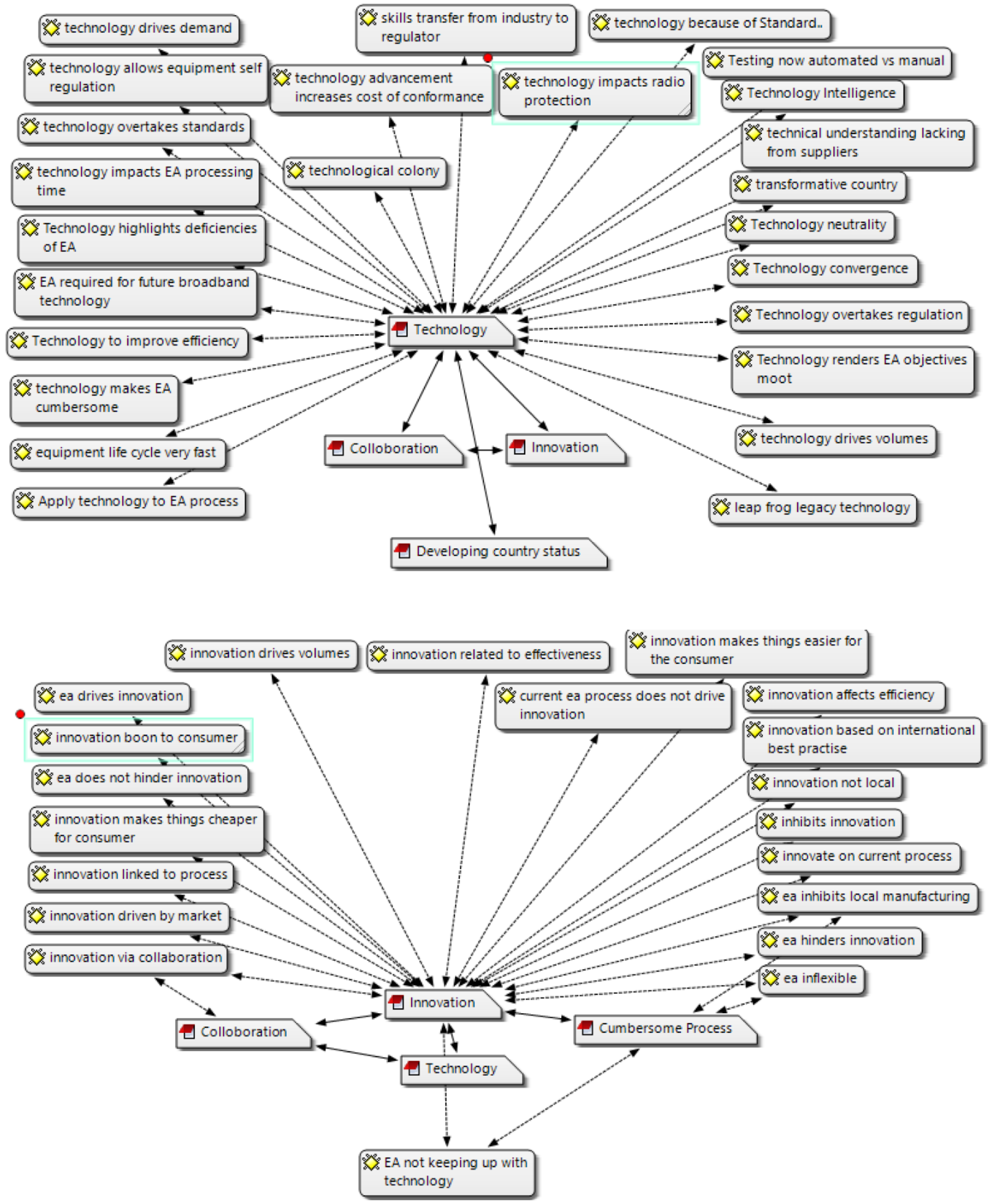


Figure 32 depicts the properties and dimensions of the key category of "Technology assimilation" using the code-families of "Technology" and "Innovation" respectively. Data analysis of these code-families coalesced into the key category of "Technology assimilation", and hence they are considered simultaneously. Technology is a key element to innovation, and the two code-families are inextricably linked. The analysis of the data reveals that technology is a key driver of innovation, and such technology is driven through assimilation. Given the incredible pace of technology, and that South Africa is a net importer of EC equipment, informants suggest that technology innovation imported into the country be assimilated into both the EA regulatory framework and the local equipment manufacturing industry. Innovation can refer to something that is new to that particular market and not necessarily new to the world (World Bank, 2010). Assimilation of foreign technology and methods were seen to promote a “technology colony” mindset, although the lack of a robust domestic EC equipment research and development environment was also acknowledged.

EA regulation was considered a bottleneck to technology diffusion and innovation. The “technology assimilation” concept was also applicable to the EA framework. Through the use of existing software solutions, the EA process could be automated, improving several elements that contribute to the problems experienced with the current approach. This can be regarded as an example of innovation. “Technology assimilation” can also involve applying technology intelligence to develop a risk rating of the equipment being approved. The EA process can exclude low-risk equipment from the approval process and is therefore also linked to the theme of innovation.

The theme of “collaboration” is linked to “technology assimilation”, when international approval frameworks are considered. Innovation through preventing the duplication of the EA process by “assimilating” the results of an International approval framework, incorporates elements of innovation and technology into a developing country’s EA framework. Collaboration is also linked to the theme of the “cumbersome process” of the current EA framework, which allows for such duplication to occur.

Technology assimilation cannot be adopted blindly, and indigenous variations based on the requirements of the implementing country is required. In this instance, the developing country status of South Africa is an important consideration when adopting technology standards from first world regions. A level of intelligence needs to be applied to the technology solution, either amending or ignoring characteristics of that solution to maximise the benefits of assimilation to the country of implementation. The data analysed suggests that such deviations should be an exception rather than the norm, as the economies of scale benefits associated with mainstream technologies are not realised by custom solutions. The earlier theme of costs has relevance here, as developing countries are extremely cost sensitive, hence technology assimilation must be based on mass market adoption. The cost of the solution and applicability to the developing country environment is secondary to the cost of the product.

Memo 5 describes the key category of “Technology assimilation.”

Memo 5: Technology assimilation

Innovation in technology has had the unintended consequence of increasing compliance costs, due to the variety of standards required for testing purposes. Technology will render EA moot. EA is not keeping up with the pace of technology.
EA is required for future technologies, notably broadband technology. 5G will make interoperability a key issue, which is driven by EA. SA imports the majority of its EC equipment and is dependent on imports. SA lacks innovation in this regard. The intellectual capital that is associated with that equipment is not passed to the country. Although SA has access to the latest technology, it does not have the research and development ability to support EC equipment. SA is thus a technology colony, that simply adopts the technology of the "coloniser". There is the opportunity to use "backward integration" or "technology assimilation" to obtain this knowledge, however, this process is a grey area that is deemed illegal in most developed countries. The example of Samsung copying the iPhone is an apt one, which eventually led to Samsung paying substantial fines to Apple for copyright infringement. There is an important caveat to the technology colony issue. South Africa cannot afford to blindly accept changes in standards adopted, in, for example, European regions. These changes may be necessary for the European market, but may only have the effect of increased testing costs for the South Africa environment.

Given the fast-moving pace of technology, it seems that equipment could self-regulate and thus render EA moot. There are self-managing equipment such cognitive radios that can prevent interference by changing frequency. Frequency coordination is one of the key functions of EA. Technology has also affected the testing process itself. Automation and digital technology have allowed testing to be conducted much quicker, allowing for greater volumes of testing to be conducted. The EA regulation itself needs to be flexible enough to keep up with technology. Regulations should refer to standard names and not versions of standards, to allow the latest version of the standard to be referenced.

Competition is critical for industrial development, and EA is based on standards, which are developed on an open platform. By measuring equipment to internationally recognised norms, a level playing field for all manufacturers is created, and this also enables competition. Equipment tested to open standards can be used anywhere in the world that such standards are used, thus again supporting competition. The current EA process deters innovation. It creates several barriers to entry, especially for small manufacturers. The EA process puts local EC equipment manufacturers at a disadvantage as the process requires testing to international standards, which is difficult and sometimes not possible in South Africa. Local manufacturers are forced to test outside the country, raising their input costs.

Innovation can be related to what the market needs, and can also be related to existing ways of doing things. It is clear that the market drives innovation and that innovation is not necessarily driven by unique solutions developed by a country. South Africa can "assimilate" technology in order to drive innovation.

Another interesting point is that we can drive innovation through collaboration, both locally and internationally. Changing how the EA process is run is also an example of innovation. Innovation could involve exempting some equipment from the EA process. Innovation is also linked to making the process easier - as an easier process means more investment which in turn will stimulate innovation in equipment. Network operators were ambivalent to the impact of EA on innovation, with some stating that while it did not encourage innovation. It did not inhibit innovation either. Automation of the EA process is an example of innovation. International best practise for EA can be assimilated in an automated manner to drive innovation.

7.2.6 Deterministic validation

Figure 33: Properties and dimensions of the key category “Deterministic validation”.

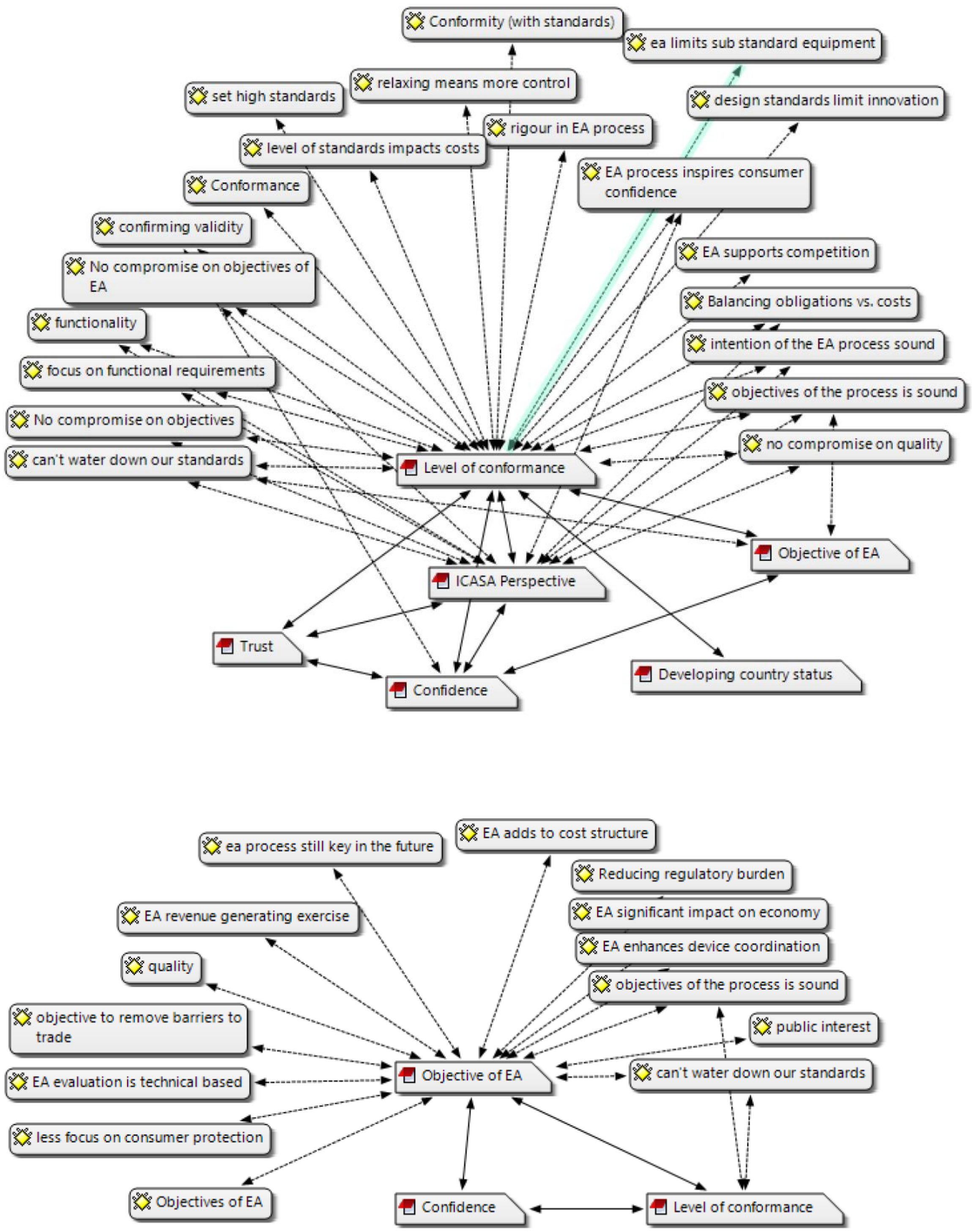


Figure 33 depicts the properties and dimensions of the key category “deterministic validation” through an analysis of the code-families “Level of conformance” and “Objectives of EA” respectively. “Deterministic validation” describes the manner and form of the current EA regulatory approach, being pre-determined in validating the technical interoperability and performance. The analysis of the data reveals that the level of performance of EA in developing countries should be limited to the technical interoperability characteristics. The objectives of EA, although steeped in a public interest guise, is currently operationalised through regulation as a technical validation of test reports. The current EA process is thus deterministic with a core focus on validation. The deterministic nature of the current EA approach is underscored by the technical regulations in place for various categories of equipment. The successful completion of the EA process is usually binary in its outcome, with a technical review process used for validation. Outside of the technical considerations, very little else can significantly impact the EA outcome. The data shows that no EA approval has ever been declined by the regulator if the technical parameters have been met. Memo 6 provides an elaboration of the key category of “Deterministic validation”.

Memo 6: Deterministic validation

The objective of EA in terms of ICASA's perspective seems misplaced. The ECA is clear in its public interest objectives, while the EA regulatory approach seems to centre on technical interoperability, standards and QoS. Safety and consumer protection are added almost as an afterthought. The process is deterministic with a core focus on the validation of the technical parameters. There is a clear indication that the current level of performance demanded by the current EA regime remain as is. The focus should be in making the conformance process easier. Given all the challenges faced by validating conformance, the ultimate goal of EA should remain as is.

There are indications, that should the level of performance required be "watered down", it may cause more problems than it would solve. This view is supported by operators, the regulator and suppliers. ICASA has a legislative mandate to allow exemptions from EA and was encouraged to implement this. Network operators, more especially the smaller operators, are more incentivised to ensure EC equipment conformance due to number portability. Number portability allows consumers to "port" or move their number to a new operator. Cellular handsets must be able to function in the different frequency band assigned to operators, as they differ from each other. Conformance to all frequency bands is thus critical to operators wanting to support number portability.

7.2.7 Decentralisation of transactional costs

Figure 34: Properties and dimensions of the key category "Decentralisation of transactional costs".

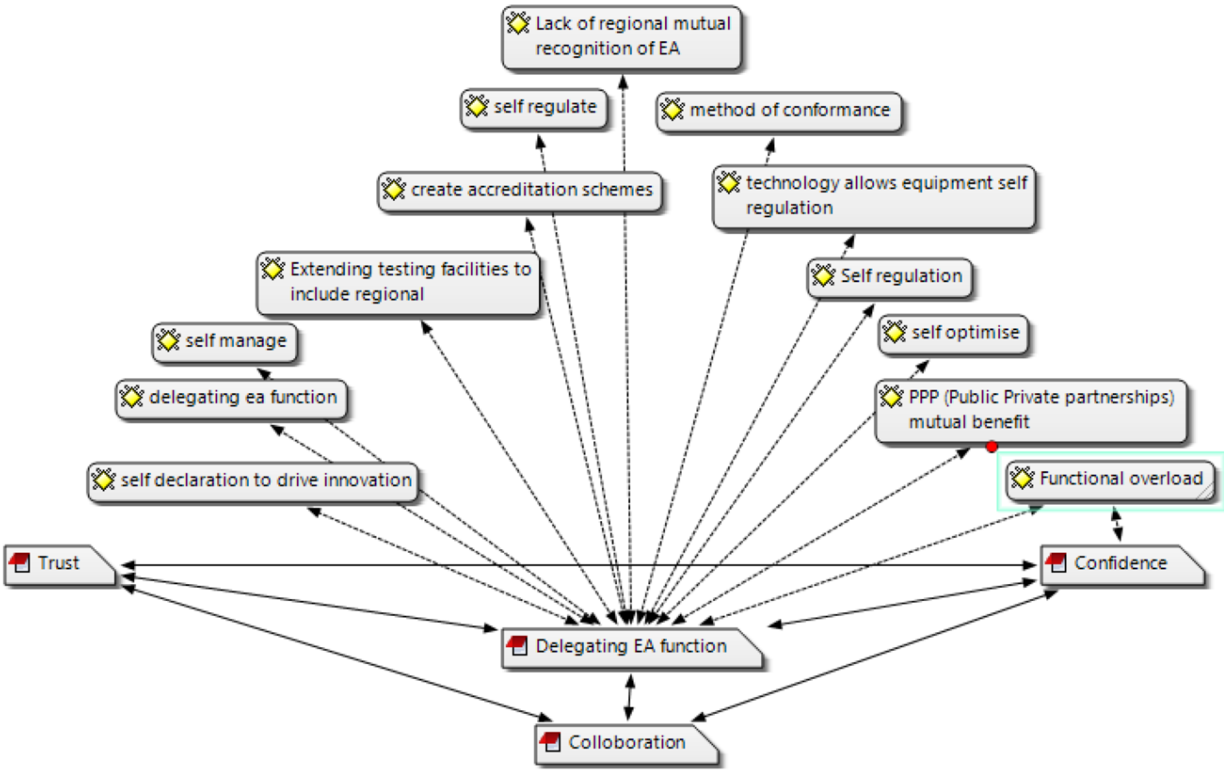


Figure 34 depicts the properties and dimensions of the key category "Decentralisation of transactional costs". Inductive analysis of the code-family of "Delegating the EA function" led to the creation of this key category. "Decentralisation of transactional costs" shifts the burden of proof of EA approvals from the regulator to selected third parties. By collaborating with these third parties, the regulator can decentralise the EA process and thus the transactional costs associated with the process. Trust and confidence are key themes that are prevalent in the data, as this collaborative process is seen to drive trust and confidence in the process. The bottlenecks created by a centralised approval process would be largely eliminated in a collaborative environment. The transactional costs may decrease substantially in a collaborative environment, as a duplication of previous approval processes would not occur. Innovation was seen to be positively impacted as well, with a key determinant of this being a quicker time to market. Decentralisation through Public-Private Partnerships (PPPs) was deemed to be the ideal way forward as it represented gains for both the regulator and industry. Memo 7 further explains the key category of "Decentralisation of transactional costs".

Memo 7: Decentralised transactional costs

ICASA is aware that the current EA process is flawed, cumbersome and creates bottlenecks. ICASA does not want to relax any requirements of the EA process but feels that the administration of the system should be better managed. There is a sense that the regulator would like to encourage a local manufacturing sector, although this seems counterintuitive, given the increasing number of imports of EC equipment into South Africa. This argument is taken further in the measures required to remedy the situation, with some representatives of the regulator looking to the DTPS and the DTI, to initiate measures to stimulate a local manufacturing sector. The regulator does not have an inward facing approach, and looks externally to address the situation at hand. Policy initiatives that are aligned with national developmental objectives are required, as these would have a knock-on effect on the EA environment. The consensus amongst informants is that the objectives and intentions of the current EA process are not misaligned. The overall perspective of EA that ICASA wants to convey is one of "integrity". The focus on integrity seems to be misplaced, considering that it shifts the focus to the EA process, rather than the objective of EA. ICASA believes that the current type approval process is recognised and respected by the industry. The best possible solution to solving the administrative burden of EA would be to decentralise the EA process to accredited testing facilities to decrease transactional costs. This shifts the onus onto a third party to prove and declare compliance. There is an exemplary model for ICASA to follow, in the outsourcing of the number portability function to an outside entity, which has proven to be successful. The focus should be on the responsibility, which should still lie with ICASA.

7.2.8 Global economy interaction

Figure 35: Properties and dimensions of the key category "Global Economy Interaction".

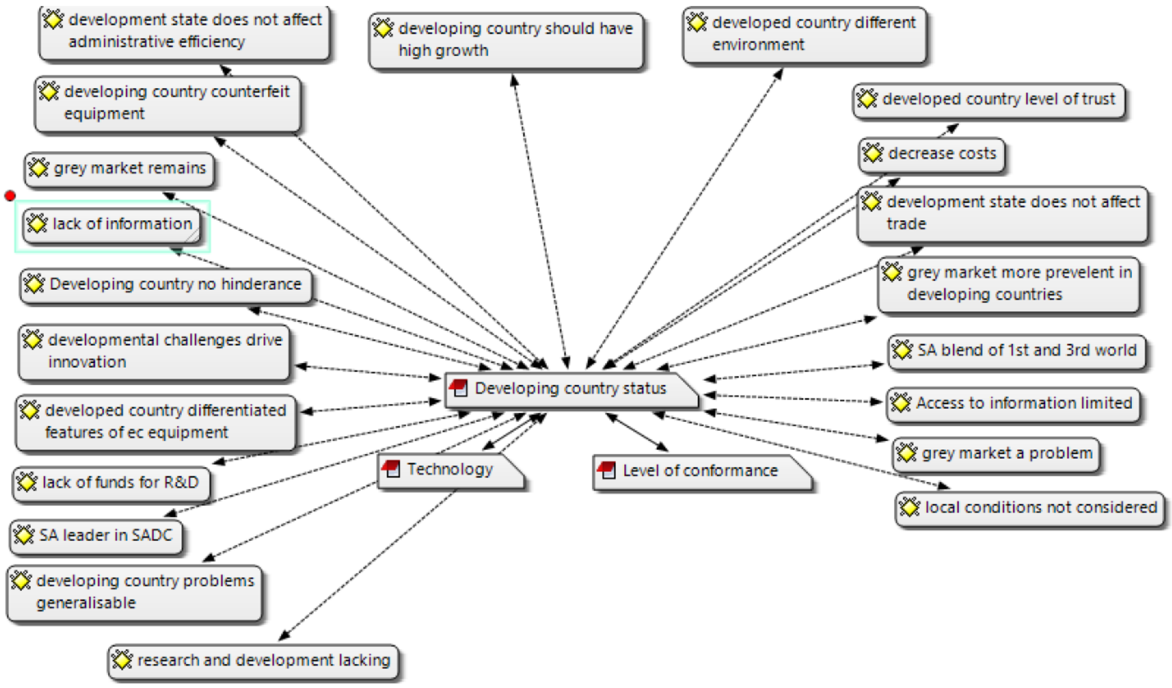


Figure 35 represents the properties and dimensions of the key category "Global economy interaction". Data analysis of the code family "Developing country status" has led to the creation of this key category. The consideration of South Africa as a developing country when analysing the EA environment, was surprisingly negligible. The EA market is driven by South Africa's interaction with the global EC economy. Standards for EC equipment and the level of conformance required to such standards, are mostly driven by global trends. Technology is the key driver of EC equipment standards, and technology adoption is dictated by the global economy. Local research and development are adversely affected as imported EC equipment are supported through global technology demand and adoption. The quality and differentiation of EC equipment is a function of the local market, and as such, grey market products enjoy a significant share of the local market. South Africa is obliged to accept global approvals and testing regimes, as the regulator lacks an internal mechanism of verification. Local conditions are rarely considered when equipment is imported, therefore indigenous public interest objectives such as safety considerations must align to the global standard. The EC market in South Africa is not significant enough to warrant any deviation from the international benchmark, hence EA public interest objectives are determined by South Africa's global economy interaction.

Memo 8: Global economy interaction

South Africa's status as a developing country should not impact its approach to EA. Even though a multitude of reasons (such as the lack of facilities for verification) impacts the ability of South Africa to effectively manage the EA environment, being a developing country does not hinder South Africa enough to impact its approach to EA. Some commentators have alluded to the fact that South Africa is not a developing country in the true sense of the definition, rather, the country was seen as being on the border between developing and developed countries. SA has some access to essential EA facilities such as test labs, even though it is a developing country. In terms of levels of development, SA has access to infrastructure that surpasses other developing countries. SA can be regarded as a mix of first and third world attributes, especially with regards to infrastructure. SA is obliged to follow global standards and is thus part of the global economy concerning the EC approvals.

Developing countries have other pressing developmental problems, such as access to essential services. ICTs are generally neglected, even though there is sufficient evidence showing the impact of ICTs on a country's development in general. The level of standards should also be kept at a first world level. Even though SA is a developing country, it is felt that the country should not "water down" the standards adopted. South Africa is setting the bar as high as global standards, with the knowledge that it may not have the resources of first world countries. Some equipment suppliers, however, felt that ICASA should bear in mind its developmental status and ability to enforce regulations, before applying first world standards. The determining factor is the source of EC equipment, with imports forming the bulk of the equipment sold in South Africa. This obliges South Africa to interact on a global level when considering the economics of the EA process, with standards and testing ultimately falling in line with global trends.

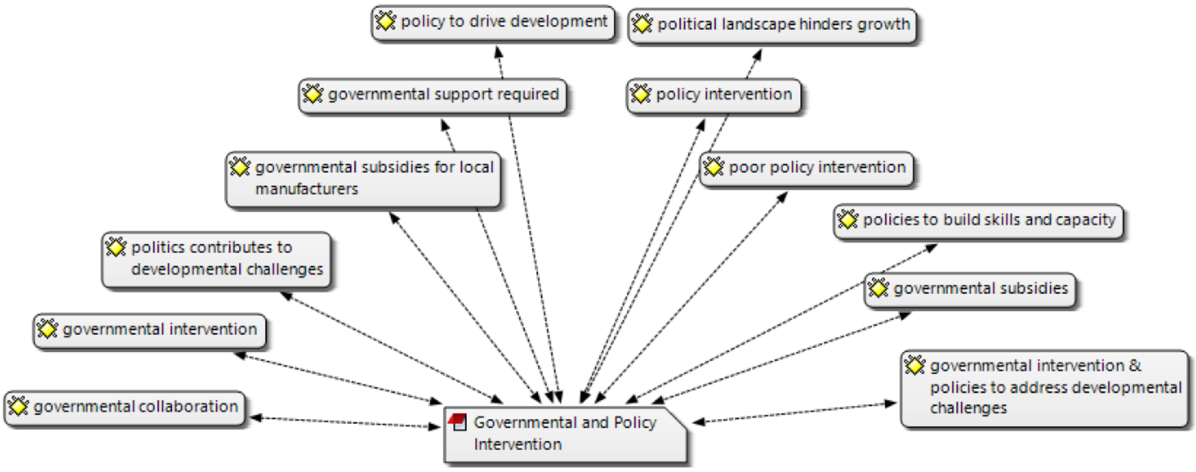
The level of standards has an economic consideration. Industry associations agree that there should be no compromise with the focus of EA. Taking this a step forward, some commentators have suggested that the opposite applies to developing countries, in that they would have to safeguard the level of standards at a level higher than developed countries, given that equipment suppliers would possibly try to "cut corners" to lower the prices of EC equipment to suit the market conditions. This will impact the EC equipment market, as sub-standard equipment may be forced into the market. Although sub-standard equipment can be tolerated in some instances, it can be critical to safety of life devices. Developing countries are more vulnerable to inferior products, especially if they do not have an EA framework. Grey market products are prevalent in developing countries. EC markets are determined by the global market and South Africa would not be able to veer too far away from global markets in terms of standards.

The statement that the more developed a country is, the less there is a need for extensive EA regulations, was not applicable to South Africa. While the inefficiencies of the current EA process is widely acknowledged, the EA process has a significant contribution to a developing country economy. The process of duplicating approvals is a source of revenue generation for the regulator, and the process of creating efficiencies in the EA process may lead to financial losses, which may in the long term, be more detrimental to a developing country.

Very few individuals and organisations are conducting EC equipment research and development in South Africa, as sufficient funding for R&D in the EC equipment market are not available. This is due to the lack of policy and political support for the EC equipment market. Real world issues such as access to information, in particular for enforcement purposes is problematic. The regulator did not have proper systems in place to manage data relating to the type approval process, leading to administrative inefficiencies.

7.2.9 Institutional void - Deliberative policy direction

Figure 36: Properties and dimensions of the key category "Institutional void - Deliberative policy direction".



The code-family "Governmental and policy intervention" is another example of a stand-alone code family, that is not linked directly to other code-families when the properties and dimensions of that code are analysed. Relational analysis of this code-family elevates it to the key category of "Institutional void - Deliberative policy direction". The key category describes the institutional void created by a lack of deliberative government policy in the EA environment. A lack of direct links to other code-families highlights the fact that, although this code is important, it is self-contained and does not contribute to the understanding of the entire EA environment. Governmental policy was seen as a tool to address developmental challenges such as skills and capacity, through subsidies aimed at promoting a local manufacturing industry. As discussed in the previous section, South Africa's participation in the global EC equipment economy is the deciding factor in determining the composition of the local EC equipment market. If South African products were able to compete on a global scale, the need for a domestic market would intensify. Although a national market would ideally impact South Africa's economy favourably, the data analysed shows this to be an adjacent issue that has little bearing on the current EA environment. Even a forward-looking view that adopts an innovative theoretical approach to EA regulations focuses on developing an approach based predominantly on imported equipment. The institutional void created by a lack of government policy to support local manufacturing, therefore, does not impact on the EA framework required to further an innovative approach to EA regulation.

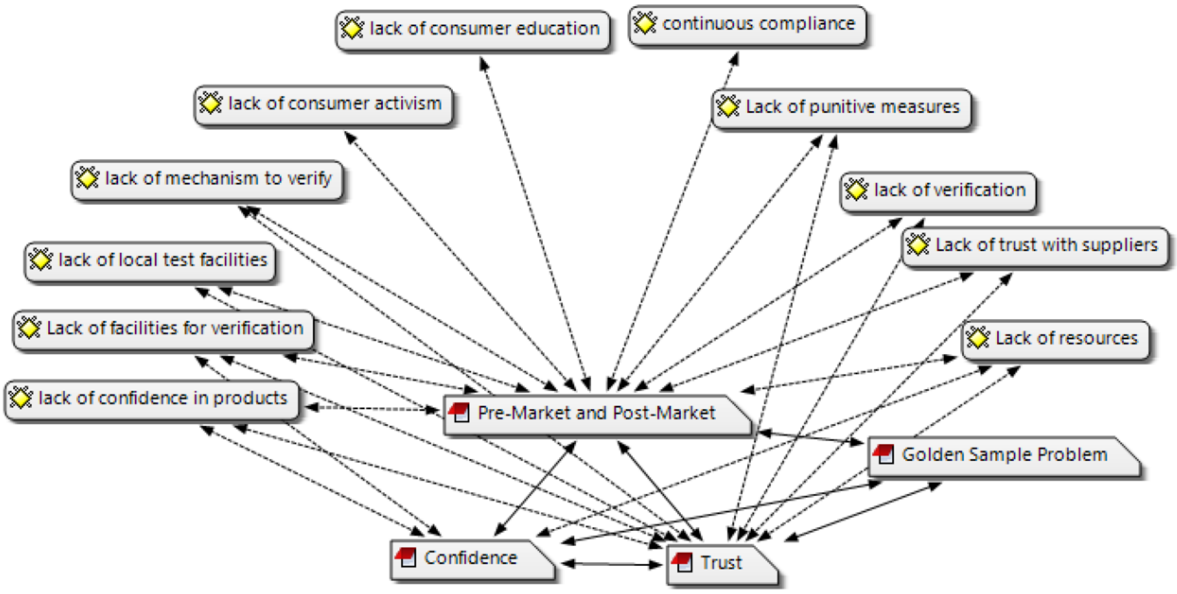
Memo 9: Institutional Void - Deliberative policy direction

There is an overarching theme to the type of support required for the EA regime in South Africa. This theme is one of policy initiatives realised through governmental support, that advances the creation of a local manufacturing EC equipment market. There is evidence, however, that the current EA regime has supported regional trade within the SADC region, without specific governmental and policy support. It was also noted the governmental policy would need to be carefully thought out in order to ensure that the economic considerations of governmental policy are successful.

Governmental policy was seen as important to ensure that revenue generation from testing remains within the country, as testing for major science projects such as the Square Kilometer Array is currently outsourced. ICT investment and policy support seem to be neglected in South Africa. There is no deliberative government policy for EA, which has led to an institutional void, especially with regards to creating a local EC equipment manufacturing market.

7.2.10 Deterrence versus knowledge-based trust

Figure 37: Properties and dimensions of the key category "Deterrence versus Knowledge-based trust".



Analysis of the code-family in Figure 37 led to the creation of a key category of "deterrence versus knowledge-based trust". The object of market surveillance was to ensure that confidence levels in the EA process are high to prevent the golden sample problem. Ultimately, market surveillance was seen as a mechanism to gauge the level of trust (or lack thereof) in the EA process. Lewicki and Bunker (1996) have researched the centrality of trust in an organisational context and suggested a three-stage model that underlies the development of trust. The first stage is referred to as "deterrence-based trust", and this stage examines an actor's willingness to trust in relation to the notion that a credible sanction exists should the actor fail to cooperate. Market surveillance validates the outcome of such trust, with a sanction being applied as a deterrence if this trust relationship was voided. This psychological model micro-level analysis of trust principles can be compared to the "command and control" approach to regulation. EA regulation provides an appropriate level of deterrence in the form of fines and sanctions, ensuring that the actor can trust the outcome of a regulatory process.

There is a broader shift in regulatory regimes, especially in the environmental regulatory field, towards new forms of governance that are moving away from the hierarchical command and control application of regulation. The new focus is geared towards joint working between government, business and stakeholders (Lange & Gouldson, 2010: 5236). This shift aligns well with the second stage of trust as defined by Lewicki and Bunker (1996).

The second stage of trust is referred to as “knowledge-based trust”, where the actor’s willingness to trust is determined by his predetermined knowledge of the context of the situation, and this knowledge forms a sufficient base from which the actor can reliably predict a rational outcome. This stage of trust can be applied to the trust matrix discussed earlier, where the regulator can display a willingness to trust certain suppliers based on a subset of criteria or predetermined knowledge. This knowledge allows the regulator to make a decision based on trust with regards to accepting or rejecting test reports from that supplier.

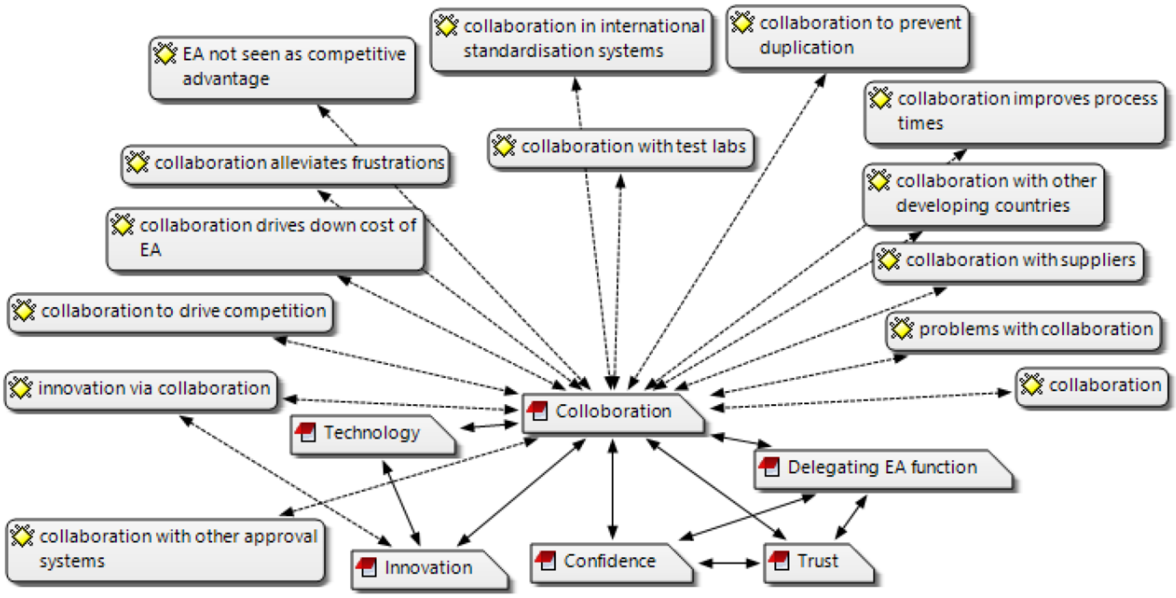
The final stage of trust is referred to as “identification-based trust”, where the communities act harmoniously to fulfil mutual gains. Given the current level of mistrust, the lack of confidence and the developing country environment, the data analysed suggests that South Africa has not yet reached a level of maturity for the market to act cohesively to realise joint gains. There is certainly an indication from the larger EA equipment suppliers to support such cohesive action, especially multi-national companies that leverage economy of scale benefits by working together with rival organisations to streamline and fast-track EA applications in different countries.

Memo 10: Deterrence vs knowledge-based trust

There is a view that post-market conformity verification is low, and emphasis is placed on pre-market conformance. ICASA concedes that it does not have the resources to conduct post-market verification and conformance testing. A key reason for this is that the testing infrastructure to conduct such post-market conformity assessment testing does not exist in South Africa. ICASA would need to develop a strong deterrent in terms of fines levied to ensure that equipment suppliers are incentivised not to break the law. Such penalties could be used to fund ICASA's future enforcement activities, and the exercise could be self-funding. ICASA is seen to be inflexible with regards to the interpretation of the EA regulations. There are specific cases that relate to the labelling of equipment that is proving problematic to operators in particular. Larger operators would respond well to identification based trust, as this is common practice in international markets. The golden sample problem is a significant one. It represents the Achilles heel of the current equipment authorisation process. The key stakeholders in the process are fully aware of the loopholes that can be exploited in the EA process by this problem. In essence, the golden sample is the EC equipment sample that is sent in for testing and equipment authorisation purposes, and this sample is not necessarily representative of the equipment that is sold for mass consumption on the open market. The golden sample is modified to ensure full compliance to EA technical standards. The manufacturer or supplier of the equipment can thus retail equipment that cannot be audited in terms of the South African equipment authorisation standards, as ICASA does not have the resources to randomly check a sample of the equipment against the test reports provided for the same during the EA process. South Africa does have some testing capabilities, but these are limited in scope and represent only a portion of the functional testing. Without a mechanism for verification, applying knowledge-based trust uniformly to all licensees is not possible. A deterrence-based trust approach remains the predominant approach to the majority of EA applicants.

7.2.11 Sub-optimal decision heuristics

Figure 38: Properties and dimensions of the key category "Sub-optimal decision heuristics".



"Collaboration" is the next code-family that has been elevated to a key category. Data-analysis of this code-family resulted in the key category of "sub-optimal decision heuristics. Figure 38 lists the properties and dimensions of the key category "Sub-optimal decision heuristics". Collaboration is a key process in the EA environment, although the data gathered shows that it is a product of the key themes of trust and confidence. Collaboration is required to capacitate the regulator with data pertinent to the EA decision heuristics. Challenges in obtaining such data limit the options available to the regulator, ultimately resulting in the regulator accepting submitted data. The trust and confidence levels of this data result in a sub-optimal decision heuristic protocol being adopted for current EA approvals.

"Collaboration" is related to five codes families in total. It should be noted that these linkages are based on shared codes and data, thus the strength of the analysis is not based simply on a code count or a count of the linkages. Although a code-family may be linked to just a single other code family, the frequency of unique codes referenced by that particular code family is essential to the analysis. The focus of the study is to develop analytical categories that explain the fundamental social and psychological processes. In this respect, a simple count of the frequency of codes and linkages will not yield as much insight into the data as a thorough analysis of the data would reveal.

“Collaboration” is linked to the code-families of “Delegating EA function”, “Innovation” and “Technology”. The memo on “sub-optimal decision heuristics” explore these linkages further, with collaboration seen as a key mechanism to divest the burden of proof regarding EA compliance from the regulator to other entities. This can be achieved via the delegation of the EA process. Collaboration drives innovation, as the regulator would have access to an independent source of verification, thereby allowing more EC products into the country. “Collaboration” is linked to “Technology”, as increasing the range and availability of EC equipment in South Africa positively impacts the technology available to the country.

Memo 11 is an advanced memo on “sub-optimal decision heuristics”. The memo describes the various forms of collaboration, both nationally and internationally. Comparisons between categories of collaboration and categories of trust are made. Comparisons between codes and categories are also made.

Memo 11: Sub-optimal decision heuristics

The issue of collaboration is two-fold. The first type of collaboration is related to the regulator collaborating directly with test labs. The second relates to South Africa collaborating with other countries to accept EA results. This is further broken down into collaboration with first-world countries and collaboration with developing countries. Collaboration with developing countries is more problematic, if this collaboration is based on mutual recognition of the EA certification. South Africa will allow other developing countries to accept its certification, but has reservations accepting results from countries that may not have the ability to conduct a comprehensive test of an EA application. Ultimately, the purpose of collaboration is in providing independent data required for EA the decision heuristic.

The pursuit of independent data is an issue of trust, where the regulator does not have sufficient trust and confidence in the EA process of developing countries. A "one-stop shop" for EA approvals in the SADC region has been long suggested. This initiative has not gained much traction over the years, possibly due to reservations that South Africa has, with regards to the ability of other member countries to conduct EA verification to an acceptable standard. This relates to both the issues of confidence in the EA process as well as the lack of facilities to conduct conformance testing. The biggest drawback to local test facilities, is that they lack the full suite of testing. ICASA sees collaboration as a key way forward to solve some of the issues of the current equipment authorisation regime. ICASA is aware that shortfalls exist in its ability to verify the functionally ability of equipment that is being tested. For that reason, the regulator suggests a higher level of collaboration between itself and other test facilities that could assist with verifying equipment. This is linked to the golden sample issue, where continuous compliance of the equipment is required. Collaboration was essential for EA, given the difficulty in gaining accreditation for test facilities and the difficulty in finding or moving a test facility. This increased the value of incumbent facilities already available. Collaboration with test houses to conduct EA approvals on behalf of the regulator is a viable option. Collaboration within the SADC region in accepting EA approvals exists, without formal governmental intervention. Countries like Botswana already accept ICASA EA certification without local testing and a formal agreement in place.
Even competing companies needed to collaborate. Some interviewees were adamant that such collaboration was the only way to drive competition, and that ICASA should be central to drive such collaboration.

Collaboration is a major driving force to reduce the cost of EA. EA should not be regarded as a competitive advantage, and all entities in SA should collaborate to prevent duplication. Major OEMs are happy to work with ICASA, by hosting informational workshops, with a view to ensure that the regulator could put the necessary approval frameworks in place for new technologies. Suppliers saw this as a win-win situation, as the regulator was able to leverage on the vendor's experience and technological advantage, while the vendor would also gain by ensuring that there would be no delays in the EA framework when the technology was deployed. Suppliers also drive technology development, especially in developing countries, as they collaborate with network providers in both developed and developing countries. Their aim is generally to deploy the latest technology to all countries simultaneously, to drive lower prices through economies of scale, hence collaboration in this sense drives innovation. SABS is an example of collaboration being implemented incorrectly. Non-intentional transmitters are tested by SABS, who require all suppliers to retest their equipment locally. This process has increased conformance costs and has led to significant delays in the overall authorisation time frames. Applying inflexible rules has the added disadvantage of encouraging suppliers to sell their products illegally.

7.2.12 The calculated concept of trust

Figure 39: The properties and dimension of the key category "Calculated concept of trust".

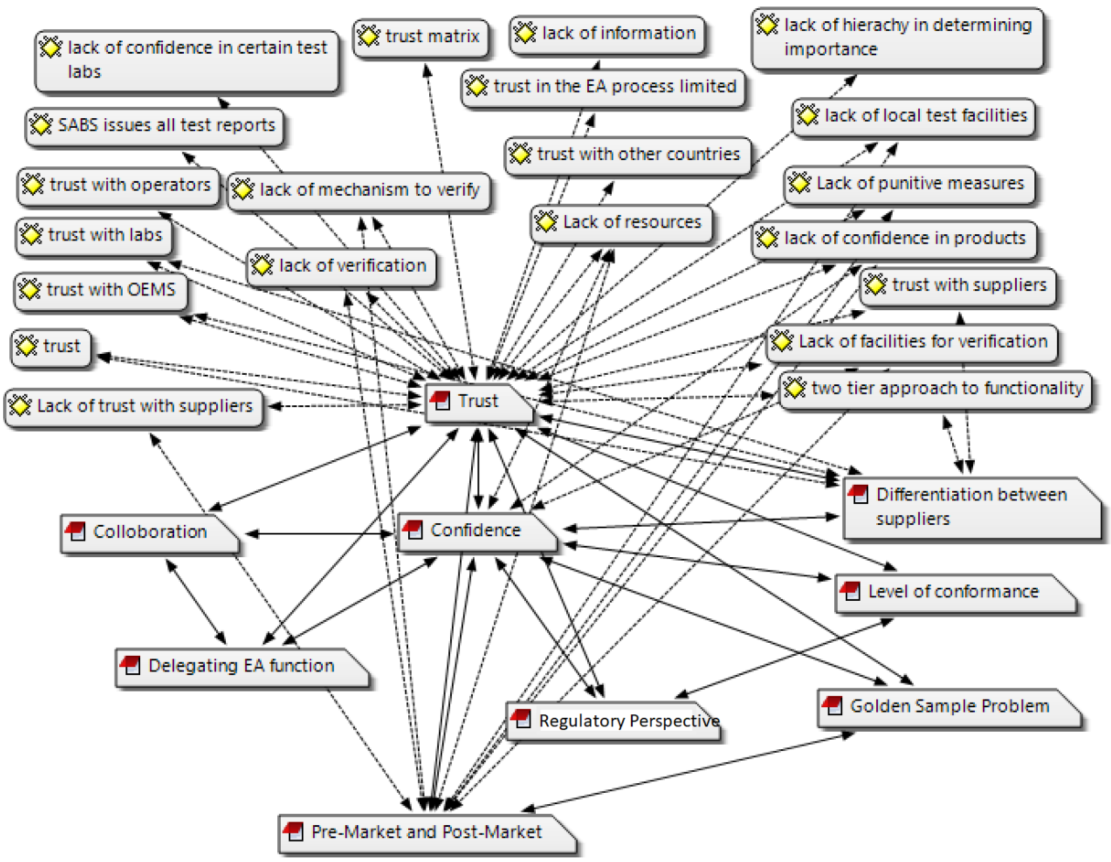


Figure 39 defines the properties and dimension of the key category "Calculated concept of trust". It is immediately noticeable that the network diagram of the code-family of "Trust" is more complex and horizontally integrated with other code-families than what has been previously analysed. This is a second code-family linked to the category of trust, as the code-family of "differentiation of suppliers" led to the creation of the key category of "differential trust", which has been discussed earlier. Trust facilitates decentralisation and encourages collaboration (Lewicki & Bunker, 1996). There exists a "calculated conception of trust" where "…the assumption that the decision to trust is predicated primarily on the computation of risks" (Lewicki & Bunker, 1996:10). This construct applies to the "trust" code-family and the analysis of the data results in a key category of "calculated conception of trust". The network diagram in Figure 39 indicates that the codes linked to the central code-family are largely risk driven - for example, the codes "lack of verification", "lack of facilities" and "lack of resources" are all risks that contribute to the regulator's decision to trust. Other codes that relate directly to trust such as “trust with labs”, “trust with OEMS” and “trust with suppliers” relate to organisational trust, which again is predicated by the regulator's computation of the risk associated with that particular group or organisation. The conception of trust is therefore calculated in the EA environment, with different metrics being applied to gauge the risk associated with a particular organisation or entity.

The second code-family related to trust is confidence. Incremental increases or decreases in confidence impact the associated level of trust. Confidence is, therefore, a further metric, in addition to risk discussed earlier, that forms the calculated computation of trust that ICASA applies to the EA process. In the EA environment, confidence is an issue concerning data obtained by EA suppliers in the form of test reports. ICASA has a lack of confidence and thus a lack of trust in the test reports.

ICASA also has a differential level of confidence in EC EA approval regimes. ICASA is confident in the results from certain approval regimes and hence has a higher level of trust in them. Regional EA approvals are subject to more scrutiny by ICASA, and hence such approvals are assigned a lower level of confidence and trust in the process. This once again is another dimension of ICASA’s calculated concept of trust when examining EA approvals conducted by other approval bodies.

The final concept of trust relates to the EA process in South Africa itself. One of ICASA’s goals is to create a high level of confidence in the EA process, in order to ensure that all stakeholders view the EA process as one that is trustworthy. The perception of trust in the EA process is key to the Regulator, who actively works to promote such a perception. Some of the Regulator’s actions include consciously adopting inefficient administrative processes, such as duplicating certain approvals, with the sole purpose of creating the perception of trust and confidence in the EA process.

Memo 12: Calculated concept of trust

Trust is a major theme that appears in the research. The trust levels are differentiated between the "major manufacturers" and the "small suppliers". There is a greater degree of trust for OEMs. ICASA has pioneered the simplified type approval process and found that there is a level of dishonesty amongst the smaller suppliers. ICASA applies a risk-based analysis when assigning a level of trust. The current EA process, although noted as a command and control process, is still largely dependent on the information available to the regulator. The validity of such information can be questionable, which begs the question whether the process is truly a command and control one. Suppliers sometimes use this to their advantage and conduct "forum shopping" amongst different staff members at ICASA, using incomplete and sometimes forged information. ICASA is of the opinion that the EC market is not mature enough to allow for a self-declaratory regime, based on the levels of trust in the market. Trust is related to the relationship with test facilities, given that ICASA has no mechanism to verify the authenticity of test reports. Trust is also related to confidence, as the lack of verification lowers the overall confidence that the regulator has in the EA process.

The EC equipment industry is aware of the inability of the regulator to conduct enforcement and is not motivated by fear of reprisal due to non-conformity to the EA regulations. The level of trust from both the regulator and the supplier would increase, should ICASA obtain a verification mechanism. EC equipment suppliers would be less likely to sell non-conforming equipment and would be motivated to adhere to the EA regulations. This would ensure that the regulator has a higher level of trust with regards to suppliers, regarding the information that they submit. There is a growing trend toward the ICASA brand value. The larger suppliers insist on ICASA EA approval, while the public in general also are aware of the ICASA logo.

Another level of trust is between the equipment supplier and the network operators. The equipment supplier invests heavily in research and development with the network operator, to deploy latest generation technologies across all areas that the operator serves. This relationship is based on trust, as the equipment supplier shares confidential technology with the network operator, by mutual economic gain. SABS has conducted a risk analysis and concluded that they would issue all test reports themselves, even if they cannot do some of the physical testing that is required. SABS has entered into agreements with several test labs to conduct testing on their behalf, but they will still issue the final test report themselves. In that way, a random sample can be tested, alleviating the "golden sample" issue and ensuring that all products are subjected to local testing. Even in an ideal scenario, the regulator does not envisage completely relinquishing the EA function, as the harmonised use of spectrum is essential and cannot be outsourced.

Memo 12 continued

ICASA is acutely aware of its lack of confidence in its own EA approval approach. A 60-70% figure is suggested as a level of confidence, but even this number seems optimistic.
RN2A notes that:

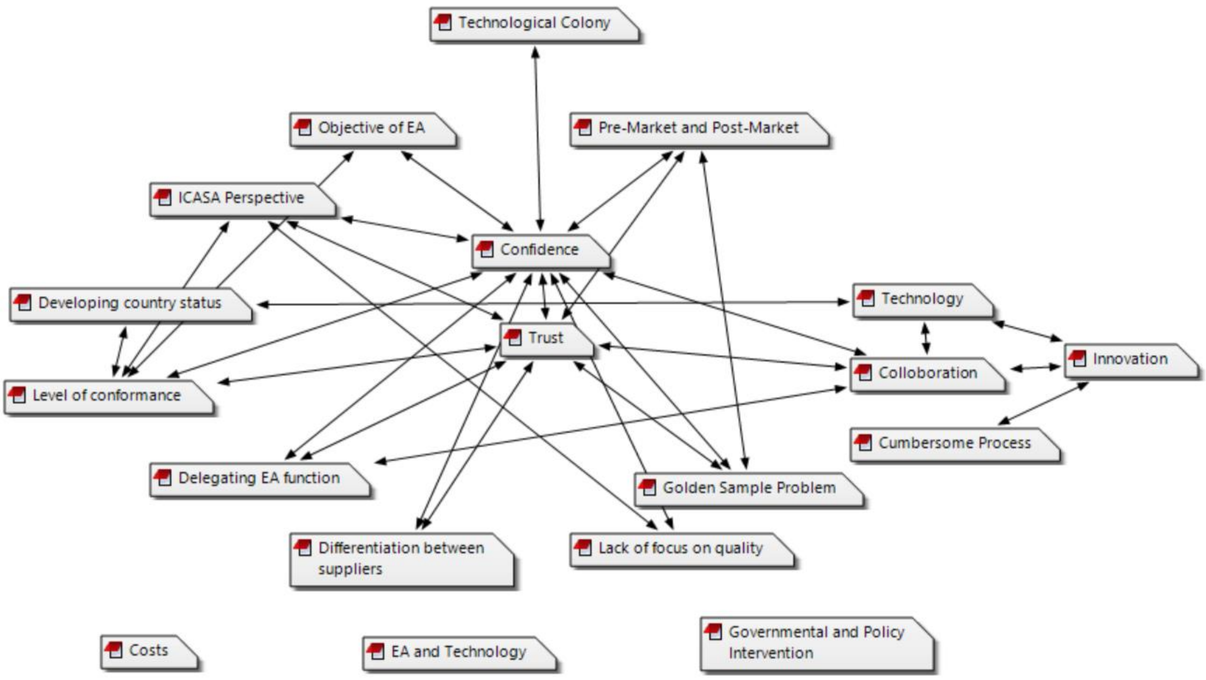
> I ask myself the question, can I really put my head on the block and say that all the equipment that is approved meet the standards? The answer is yes and no. You are basing your approval on the test reports from accredited laboratories. Some of the laboratories - you do not even know them and are not aware of them. It is challenging to confirm that the particular product is of good quality. More especially if the documentation can be changed. Hence I said yes and no. Yes, if it is coming from the proper labs. No forms a percentage that we do not have confidence in.

ICASA is aware that the EA process does not ensure confidence and segregates suppliers into two general categories, the "major manufacturers" and the "small suppliers". The issue of confidence in the test reports seems to be directed at the "small manufacturers". ICASA also believes that its engineers are not involved in the EA process at a technical level. They do not actually test any equipment themselves. They are not involved in the testing process at all, hence their ability to properly make a determination on the eligibility of equipment to be approved is diminished to an extent. Operators question the value of the EA process, given that there is no post-market surveillance or even validation testing at the approval process. ICASA, however, believes that confidence in the system will be developed over time.

Network operators allude to the fact the EA process provides a level of confidence that the equipment tested, meets the functional requirements. Confidence is also linked to the objectives of EA, namely to create a level of confidence for the consumer who purchases the equipment, in terms of the safety and performance of the equipment. ICASA provided examples of how it attempts to increase confidence of the EA process. The first is to conduct a verification of the lab that conducts the testing, and the second is to conduct a technical evaluation of the test report. EA should provide a reasonable level of trust, not necessarily a guarantee of trust.

7.3 The determination of a substantive grounded theory of EA in developing countries

Figure 40: Properties and dimensions of all code-families.



In developing a substantive grounded theory of EA regulation in a developing country, all code-families were once again analysed with linkages based on the associated data. This differs from the data analysis in the preceding sections, where analysis between codes and data as well as codes and code-families were made with the intention of developing the key categories. To test the completeness of the key categories in developing the substantive theory, further analysis between code-families and code-families are made using theoretical sampling. All the data gathered was revisited in the analytic process, with interview data, in particular, being re-analysed with the purpose of validating the emerging key categories. Particular emphasis was paid to the outlying constructs that were elevated to code-families, such as "costs", "governmental and policy intervention" as well as "EA and technology" to solicit data to support the inclusion of such codes into the developing theory. Figure 40 represents all the properties and dimensions of all code-families. The figure provides a useful illustration in the form of a network diagram, showing the linkages between the various constructs. As with previous network diagrams, the actual data sources have been removed from the network to prevent clutter, along with the key-codes that were present in all networks diagrams thus far. Only the linkages between the code-families are listed. It should be noted that the diagram is a result of further iterations of theoretical sampling, with the linkages drawn from re-analysing the data linked to these code-families. The code-families of “trust” and “confidence” were validated during the data analysis, to determine the linkages between these categories and other code-families. The result of the theoretical sampling reveals that almost all the code-families identified in the initial data analysis are linked directly to either “trust” or “confidence”. The outlying code-families were noted as “costs”, “governmental and policy intervention” as well as “EA and technology”. These code-families were not supported by the extended theoretical sampling process and hence do not contribute toward the development of the substantive theory. “Technology”, “cumbersome process” and “innovation” as code-families were carefully analysed through theoretical sampling and the linkages differ from the initial data analysis. These code-families are linked primarily to the “developing country” code-family as all data related to the aforementioned code-families are subsumed by the “developing country” code-family.

The constant comparative process of comparing data with data, data with codes, codes with codes, codes with code-families and code-families with code-families eventually led to the development of the core category. Figure 40 shows the central linkage to all code-families is either the code-family of “confidence” or “trust”. Using several iterations of data analysis, the core category was determined through conceptual rendering as the “calculated concept of trust”. Although the network diagram linkages in Figure 40 show the code-family of “confidence” appearing as the core category, the data analysis discussed earlier where the code-family “confidence” was shown to be a determinant of the key category “calculated concept of trust”, was further ratified through rigorous and continuous theoretical sampling. The “calculated concept of trust” is thus the overarching category that conceptualises the emergent theory of EA in developing countries.

7.4 The process of theory building by iterative theoretical sampling

The foundational elements of the nascent theory are determined by applying inductive reasoning to the key analytical categories. An interesting finding from the iterative data analysis process showed that the initially argued contestation between the public interest paradigm of regulation and the economic theory of regulation were *not* key determinants of EA in a developing country. The theme of trust emerged as the golden thread that permeated through all the key categories. Trust as a theme on its own, however, was deemed to be too general did not function at a conceptual level of applicability and was not considered analytical enough to be explicated to a theoretical level. Theoretical saturation showed that the themes of trust and confidence were convergent and ultimately, after multiple iterations, were expressed as a "calculated concept of trust". The "calculated concept of trust" was more nuanced, retained the complexity of the concept of trust and had definitive linkages to all the key categories.

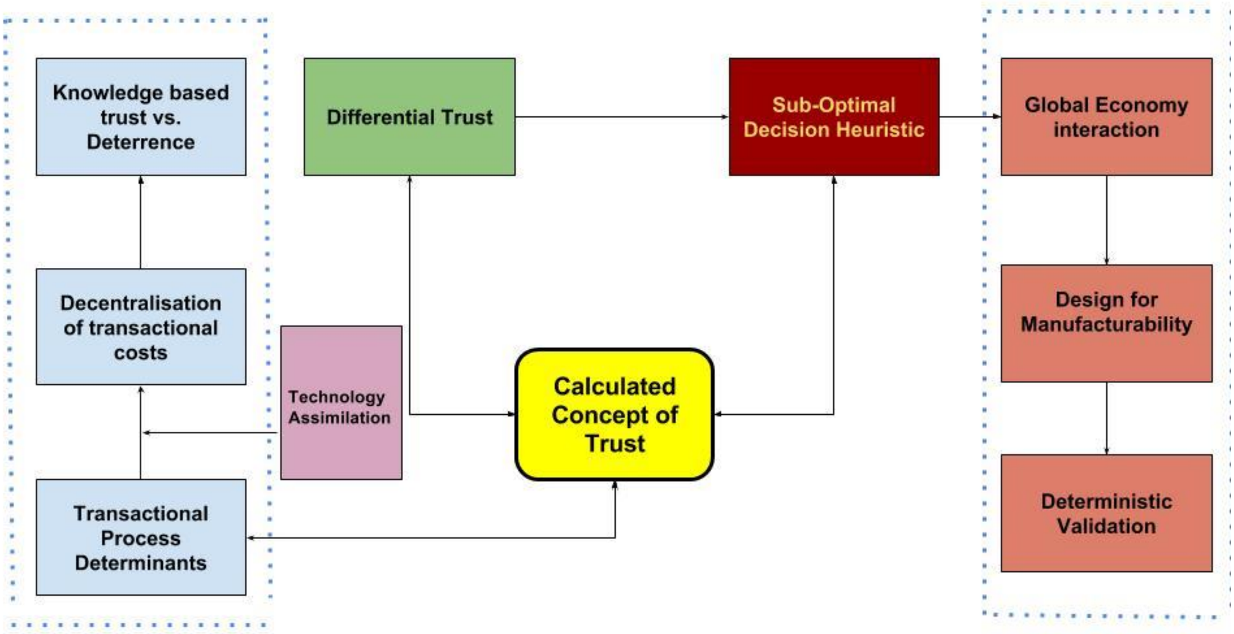
Table 3: Definitions of the elemental conceptual categories that would be used to develop the final theory

Key Category	**Definition**
Calculated concept of trust	The concept of trust in the EA environment is characterised by the risk associated with a particular organisation or entity, predicated by the regulator applying different metrics for a tacit computation of trust. This tacit calculation is the process of mental agility that the regulator goes through and is based on the assumption that the decision to trust is largely risk driven. This risk assessment leads to the differential trust concept.
Differential trust	The level of trust assigned by the regulator to an EC equipment supplier is based on the tier status and salience of that supplier, with tier one suppliers enjoying a higher level of trust than tier two. This belief is cemented by the initial interaction between tier two suppliers and the regulator and is a contributing factor to the regulator's preliminary trust belief towards tier two suppliers which ultimately leads to a lower risk rating. The risk associated with a supplier impacts the decision heuristic employed in the EA process. Differential trust is a mechanism

	that the regulator employs to deal with the reality of sub-optimal decision heuristics.
Sub-optimal decision heuristics	The regulator requires data pertinent to the EA process. The source of the data coupled with an inability to verify the data, limit the options available to the regulator, ultimately resulting in the regulator accepting unverified data. The trust and confidence level of this data results in a sub-optimal decision heuristic protocol being adopted for current EA approvals.
Global economy interaction	The consideration of South Africa as a developing country, when analysing the EA environment, is negligible. The EA market is driven by South Africa's interaction with the global EC economy. Technology is the key driver of EC equipment standards, and technology adoption is dictated by the global economy. South Africa's is obliged to accept global approvals and testing regimes, as the EC market in South Africa is not sufficient to support an indigenous market.
Design for manufacturability	Design for manufacturability refers to the proactive optimisation of EC equipment of the entire equipment value-chain for the global market, prior to sale to ensure that an appropriate balance between cost and quality is achieved. Safety and regulatory compliance are key determinants of the process- hence EC equipment is designed with EA conformity in mind.
Deterministic validation	The current EA regulatory approach is pre-determined, as it validates known technical interoperability and performance standards as most EA equipment are designed for manufacturability. The current EA process is thus deterministic, with a core focus on validation. Technical regulations are usually binary in their outcome, with a technical review process used for validation. Little else can significantly impact the EA outcome.
Transactional process determinants	Various exogenous factors impact the EA transaction and are determinants of the overall efficiency of the EA process. At the same time, other key transactional determinants with the ability introduce institutional process efficiency are ignored. Some of the current processes that determine the current EA process are

	responsible for significant negative externalities to the EC equipment market.
Technology assimilation	EA innovation through technology could be driven using existing software solutions, automation coupled with incremental process improvements, would mitigate the transactional process determinants. Applying technology intelligence is required in order to develop a risk rating of the equipment being approved as well as assimilating the results of a proven international approval framework, are further examples of EA innovation. Technology assimilation must incorporate indigenous variations based on the requirements of the implementing country.
Decentralisation of transactional costs	An innovative EA approach would aim to shift the burden of proof of EA approvals from the regulator to selected third parties. By collaborating with these third parties, the regulator can decentralise the EA process and thus the associated transactional costs. Decentralisation through Public-Private Partnerships (PPPs) was deemed to be the ideal way forward, as it represented gains for both the regulator and industry.
Deterrence versus knowledge-based trust	ICASA applies “deterrence based trust” in relation to the notion that a credible sanction exists, should an actor fail to cooperate. EA regulation provides an appropriate level of deterrence in the form of fines and sanctions, ensuring that the actor can trust the outcome of a regulatory process. An innovative EA approach should incorporate “knowledge-based trust”, where the actor’s willingness to trust is determined by his knowledge of the context of the situation, and this knowledge forms a sufficient base from which the actor can reliably predict a rational outcome.

Figure 41: The calculated concept of trust



Applying axial coding once again at this stage helped in comparing key categories with other key categories. Such a comparison assists in developing a holistic view of the concepts with the aim of developing a substantive theory.

7.5 An explication of a substantive theory - a calculated concept of trust of EA regulation in developing countries.

The EA framework, applicable to efficiency driven and transitional countries with a relatively rich EA testing infrastructure, is predicated on a calculated concept of trust. The regulatory authority employs a tacit computational mechanism to determine the level of trust when dealing with EA applications. The rationale for such an approach is largely driven by sub-optimal decision heuristics available to the regulator, as a result of the inability to corroborate technical data associated with the EA process. The regulator thus applies a differential trust paradigm, assigning a high level of trust to EA suppliers with a high level of salience.

The global economy has a significant impact on the EA approach. A developing country is primarily a net importer of EC equipment and is therefore compelled to adopt international technology trends and standards. EC equipment is designed for manufacturability, including evidentiary data required for global EA approval. The global EA approval process is thus deterministic, with a binary result either approving equipment for the global market or not. Developing countries have therefore little control or influence over the global EA process or the source of the evidentiary data. The calculated concept of trust is once again applied, grounded in the source of the data provided to the regulator.

Trust in the sources of data is fundamental to the regulator. An innovative approach to EA regulation should be based on mechanisms to validate data integrity, such as collaboration with multiple stakeholders to promote data validation. A consequence of collaboration is the decentralisation of transactional costs associated with the EA process. Using appropriately vetted stakeholders to validate EA evidentiary data decentralises the EA transactional costs - which has traditionally been the domain of the regulator. Collaboration also has the effect of facilitating knowledge-based trust in the EA process, providing the regulator with a sufficient base to reliably predict a rational outcome to the EA process. When juxtaposed with the current deterrence-based trust approach of the EA process, a knowledge-based trust approach would not require the threat of a credible sanction. Knowledge-based trust is thus a positive contributor to the calculated concept of trust in the EA environment.

There are numerous exogenous transactional process determinants impacting the overall efficiency of the EA process. Applying technology to the EA process can improve institutional efficiency. Assimilating technology from other EA environments is an example of innovation, although such assimilation must incorporate indigenous variations based on the requirements of the implementing country. The goal of applying technology and innovation to the EA process is ultimately centred around increasing the trust value proposition.

7.6 A revisit of the scholarly literature reviewed - Theories of trust

An extensive literature review was conducted at the beginning of the research. This literature review focused on the key theories applicable to the EA environment, namely regulatory theory, public interest theory and the economic theory of regulation. The grounded theory method of qualitative data analysis, however, suggests that a literature review is conducted at the end of the research process. This research has followed the traditional route of defining the key theories upfront but also examines the theories that may not have been considered at the start of the research journey. One such analytical category that has proven to be vital from the data analysis conducted in this study was trust theory.

The definitions of trust are varying and broad. The definition of trust is dependent on its application in social interactions. For example, researchers view trust as encompassing psychological, cognitive, emotional or behavioural dimensions (Lewis & Weigert, 1985: 969). In the context of this study, the existing theories trust can be narrowed to "institutional based trust", which is defined as "the belief that needed structure conditions are to enhance the probability of achieving a successful outcome" (McKnight & Chervany, 2002). In the literature surveyed earlier, it was noted that regulation is the product of an environment in which it is applied to address market failure, especially in instances of a natural monopoly (Mclean, 2004:42). In such instances, the multi-dimensional construction of trust is applied to the narrow domain of regulation, where regulation provides the structured conditions required to achieve a level of trust in addressing market failure. Regulation can thus be considered as a deterrent, as the level of trust that the public has in the market behaving in a manner that instils confidence is limited. Cline and Williamson (2016) explore this linkage and find that formal regulation can be considered as a substitution for trust, as it provides an alternative protection mechanism for the shareholder (albeit in the financial sector). The concept of trust is therefore closely linked to regulation, and it is not surprising that trust is an important theory relevant to this study. Aghion *et al*. (2010) show a strong relationship between government regulation and trust. In this study, transitional economies similar to South Africa are researched. These economies are characterised by high regulation, low output and low trust. The low levels of trust feed the requirement for more regulation, which in turn contributes to lower output. This self-feeding cycle is a challenge to developing countries looking to increase economic output. Although several factors are discussed in the study that impacts this cycle, trust is an imperative process required to restore the balance necessary to break the cycle.

Shapiro (1987) notes that deterrents are not a form of trust support, as they are only used when trust breaks down. Public interest objectives would thus result in the regulator having an arduous task of creating an environment that instils trust in the consumer, as the social interaction that helps form personal bonds and creates a sense of security, is absent from interactions within formal institutions such as the regulator. Several scholars allude to this situation and note that in modern market economies, impersonal, faceless and large-scale exchanges are common, and the trust derived from social ties and direct personal contact is limited and fragile (Shapiro, 1987; Zucker, 1985; Yamagishi *et al.,* 1998; Wand & Gordon, 2011). The opposite holds true as well, as Lange and Gouldson (2010: 5235) point out that "..where trust is pervasive and embedded in social interactions, cultures of trust develop". The EA process is largely devoid of interpersonal contact, and an entire EA application can be processed without a face-to-face meeting between the regulator and the supplier. Electronic applications are encouraged, and face-to-face meetings are allowed in exceptional circumstances, given the volume of applications that the regulator has to deal with. This lack of social interaction is a factor that limits the building of the trust relationship in the EA environment.

Trust is also related to development, and there exists sufficient empirical evidence suggesting that trusting societies experience higher levels of economic and financial development (Cline & Williamson, 2016:573). Baliamoune-Lutz (2011) further defines trust-based social capital as a key enabler of institutions in developing countries. Trust is thus a key element in both regulation and development, having a measurable socio-economic impact on a developing society. Social capital is an important term used in this regard, and can be defined as the:

> ...obligations and expectations, information channels, and social norms. Social capital in the form of cooperative behaviour, norms and values in a society that serve to enhance trust among individuals and facilitate transactions by reducing (or even eliminating) costs associated with acquiring information and with monitoring (Baliamoune-Lutz, 2011:336).

This social capital is required by the actors in the EA environment to ensure that the public interest objectives are met during the EA process. The regulator is also aware of the social capital obligations and has put in mechanisms to try to alleviate constructs that impede public interest objectives.

Schilke and Cook (2013) define three categorically distinct trust relations that can be recognised as relevant to trust in inter-organisational relationships:

i. individual–individual (interpersonal)
ii. individual–organisation (institutional)
iii. Organisation–organisation (inter-organisational).

The one-on-one interactions between the stakeholders of the EA process form the interpersonal level of trust. Individual actions and relations are related to the individual's socioeconomic characteristics. These interactions could be represented by suppliers and specific regulatory staff members, as well as individual licensees represented by a proxy and the specific regulatory officials.

To determine a national characteristic, empirical studies usually aggregate individual-level data to the national level (Wand & Gordon, 2011: 584). In this manner, empirical evidence from the EA environment is representative of the industry view of trust. While this research is cognisant of the fact that a multi-level perspective is required to develop an all-encompassing formal theory of trust, a substantive theory of trust based on the population sample surveyed is certainly possible. The differentiation between individual and collective levels is important, as it is accepted that only individuals are capable of trusting, as organisations are incapable of creating a "trust intention" and hence the collective individual trust shapes the multi-level organisational or institutional trust (Wand & Gordon, 2011: 584). Schilke and Cook (2013) conclude that trust is the fabric of inter-organisational relationships and that such trust can be differentiated into a granular understanding of individual actions and relations. In the individual-organisational perspective, the specific regulatory staff member interactions ultimately represent the regulator. In the same manner, the individuals representing the EC equipment suppliers ultimately represent the EC equipment supply industry.

The third level of trust applicable to the EA environment is the organisation-organisation level of trust. Given the various stakeholders involved the EA process, the issue of organisational trust is an important one. ICASA's dependence on test results from third parties raises issues of organisational trust between ICASA and the various testing entities. The developments around a regional mutual recognition regime raises the inter-organisational trust between ICASA and other SADC regulators. Cline and Williamson (2016:579) find that in instances when trust is low, formal regulation is required to promote cooperation and economic exchange. In the case of ICASA trusting the output of other regional regulatory bodies, formal structures would be required to promote cooperation and increase the level of trust. Such structures may involve setting uniform performance standards for the regional regulatory authorities.

The earlier reference to "informational deficiencies" in the literature review of this study dealt with the regulator's inability to obtain information relevant to the regulated industry. This has a significant impact on trust and choice, as the regulator may not have a choice on whether to trust or not. Lange and Gouldson (2010: 5236) state that:

> Regulators do not always know the regulated process, as well as the regulated, do. Hence, they may not have a choice about whether to trust the regulated, but have to trust the information that they provide, for instance in the context of licensing and enforcement. Extensive collection and scrutiny of information may involve a disproportionate investment of both business' and regulators' resources.

Although their study dealt with environmental regulation, the same principle would apply to the EA environment, as this study shows that the regulator could not verify information provided by EC equipment licensees. The cost of verifying information provided to the regulator would be significant, and could disrupt the EC equipment economic model. Trust is, therefore, a key concept in the EA regulatory framework.

Trust can be based on several variables, such as religion, income, political institutions and ethnicity amongst others (Cline & Williamson, 2016:580). The 'hierarchies of trust' concept discussed earlier is based on the same principle, applied to an organisational level. Suppliers with higher market share, brand value and financial resources were deemed more 'trustworthy' than smaller suppliers, by ICASA. These determinants of trust contribute towards the overall "calculated concept of trust".

Trust and innovation are also linked. Lange and Gouldson (2010: 5235) note that "Trust-based, cooperative styles of regulation have contributed to the development and diffusion of new technologies and techniques, thereby improving environmental performance". Although their study is based on environmental regulation, the findings are of relevance in linking trust theory and innovation to regulation. Lange and Gouldson (2010) also draw an interesting parallel between trust and public interest, which is considered a key theoretical basis for EA regulation. They note that actors would trust those that they believed acted in the public interest. A relationship of trust is crucial and challenges the dominant assumptions of conflicting interests of actors in a regulatory environment.

Chapter 8: Evaluation of the emergent theory and conclusion

This study aimed to develop an innovative approach to EA regulation in a developing country, using a grounded theory approach to qualitative data analysis. The central research question asked:

> *In which ways can innovative theoretical approaches to regulation be applied to the EA regime of a developing country such as South Africa, in order to address the limitations presented by the current theoretical approaches?*

This final chapter of the thesis, therefore, evaluates the substantive emergent theory, to standards and measures of the defined grounded theory process in answering the research question. Evaluation of the constructed theory also indicates how well the emergent theory renders the data gathered during the research process.

A discussion on how well this thesis contributes to knowledge is accompanied by a reflection of the extant literature on trust theory, as well as positioning the study within the greater body of literature related to trust, regulation and EA. Originality is an important consideration for the creation of new theoretical insights, and a summation of originality in both content and methodology is included below. The final section of this chapter is allotted to a discussion of the study limitations and areas of future research.

8.1 Evaluation of the emergent theory

Classical grounded theorists generally cite Glaser's (1992) criteria of fitness, workability, relevance and modifiability, when evaluating a grounded theory study. Furthermore, as the research has largely followed Charmaz's (2006) grounded theory methodology, her evaluative criteria seem more relevant to this thesis, as it provides an accompanying verification framework to complement her suggested methodology . It is important to note that grounded theory studies do not necessarily result in an interpretative result or verifiable findings, as "…the essence of a classic grounded theory study is a conceptual suggestion rather than the verification of fact" (Glaser, 2003). Charmaz (2006:182) lists the following four criteria as a basis for acceptability of the grounded theory process. These criteria are credibility, originality, resonance and usefulness and are discussed in more detail in the following:

8.1.1 Credibility

Charmaz (2006) lists several conditions that the researcher should meet when testing the credibility of a grounded theory study, including (i) intimate familiarity with the setting or topic; (ii) range, number and depth of observations in the data; (iii) systematic comparisons between observations and categories; (iv) the range of empirical observations; (v) links between data and analysis and argument and (vi) evidence to allow for an independent assessment.

i) The thesis was completed over a three-year period and included data from intensive interviews with 25 key stakeholders in the EA environment as well as an extensive analysis of 53 documents relating to the EA field. The aforementioned data collection strategy coupled with the researcher's access to EA specialists contributed to the researcher achieving an intimate familiarity with the topic of EA.

ii) As noted in the previous section, the range of data collected was recorded, transcribed (in the case of interviews) and coded using the grounded theory doctrine. A total of 2507 codes were generated, of which 938 were unique codes (A complete code list is included in Appendix F). Successive levels of analysis created code families and then eventually key categories. All relational observations were based directly on the data, and network diagrams of key data were included as part of the study. The range, depth and number of observations strived to faithfully represent the data gathered and provided a sufficient foundation to merit the claims made in the study.

iii) Comparisons were made iteratively (following the grounded theory methodology) between codes, code-families and key categories. The key categories contain analytical memos that made systematic comparisons between the categories and other observations. These observations included other categories, data, codes and code-families. Network diagrams were also used to illustrate linkages between the key categories as well. Using the network diagram was ultimately the most important tool in assisting with determining the core category of the research, as the Atlas Ti. Program recorded all linkages, notes and associations made by the researcher during the coding process.

iv) The key categories in the study cover a wide range of empirical observations, all centred around the calculated concept of trust. The determinants of the calculation of trust are distinct empirical observations, ranging from the decision heuristics available to the regulatory authority to the differential level of trust that the authority applies to EA applications.

v) A powerful tool that is available in the Atlas Ti. program, is the ability to illustrate links between key sources of data as a network diagram. Codes that are "grounded" in the data, meaning that they have a particular quotation associated with it, can be shown graphically as part of key themes. All data linked to that particular theme or key category as it is referred to in the thesis, demonstrate a verifiable logical connection to that category. These links assist in building the category in a multifaceted manner, as they are drawn from various data sources and codes. Applying inductive logic and critical thinking provides the level of abstraction required to elevate these categories into key aspects of the argument or theory being developed.

vi) While it is not possible for the reader to view all data associated with codes (such as quotations adopted directly from the transcription of the interviews), a substantial number of "raw" codes are included in the analysis of the data. Each step of the analysis, from the creation of code families from the coded data, to the elevation to key categories, is carefully documented, allowing a reader sufficient evidence to form an independent assessment of the claims made in this thesis.

8.1.2 Originality

The section on originality, while included here for completeness to highlight all of Charmaz's (2006) categories when evaluating a grounded theory study, has been explicated in detail in section 8.3 of this chapter. Originality is a key component of this thesis, and thus a dedicated section has been included.

8.1.3 Resonance

Charmaz (2006:182) suggests several criteria in evaluating the resonance of a grounded theory study, including (i) the fullness of the studied experience; (ii) revealing liminal meanings; (iii) drawing linkages to larger collectivities and (iv) making sense of the grounded theory.

i) The key categories of this study ultimately subsume all the collected data and thus represent the complete studied experience. Certain categories, however, were not included as part of the final theoretical narrative. The reasons for the exclusions have been documented in the study.

ii) The code families and "trust" and "confidence" highlighted the difficulty in revealing the intention and direction provided by the data. Several iterations of theoretical sampling were required to define the concept of "trust", which was multifaceted and intrinsically linked to the concept of "confidence". Taken-for-granted meanings of these words, or any of the key categories, were therefore not helpful.

iii) The data collection strategy was intended to adopt South Africa as a proxy for developing countries, to generalise the findings of this study and to draw linkages to the larger developing country environment in general. The data, however, did not indicate as such. This finding is discussed in further detail in the study limitations included in this chapter.

iv) The theory was discussed with several key informants to the research process who confirm that the findings provided them with a deeper understanding of the key psychological processes that underpin the EA framework in South Africa.

8.1.4 Usefulness

The final measure of the evaluative criteria of the grounded theory method is usefulness. Charmaz (2006:183) provides guidelines regarding the usefulness of the analysis, including (i) useful interpretation; (ii) generic processes derived from the analysis; (iii) examining generic processes for tacit implications; (iv) further research in other substantive areas and (v) contribution to knowledge.

i) In answering the research question, the analysis of the data provides a level of direction that describes the underlying theoretical approach to EA regulation. Given that the research question itself was framed to develop a theoretical perspective, the applicability of the research was not aimed at developing an everyday solution. In further answering the research question, the study details the limitations of the current theoretical approach by highlighting the inability of the regulator to validate evidentiary data. The emergent theory details an innovative approach to EA regulation and is applicable to efficiency driven and transitional countries with a relatively rich EA testing infrastructure, wherein a decentralised approach to EA is suggested. Such an approach decreases costs associated with the EA process as well as increases trust in the sources of data.

ii) Several generic processes were identified in the key analytical categories. These categories are all related to the "Global Economy Interaction", where the global generic EA process becomes the de facto process to all linked economies.

iii) Interaction with the global economy has a tacit implication of global standards adoption. The thesis raises issues about blindly accepting the standardisation framework of other approval systems.

iv) This is discussed further in section 8.3 of this chapter.

v) This is discussed in detail in the next section of this chapter.

8.2 Contribution to theory

The concept of trust pertaining to regulation is widely discussed in the available literature. These studies focus predominantly on the levels of trust in regulators and regulatory processes. The concept of trust in the prevailing literature is therefore largely endogenously focussed, with the regulator and regulatory decisions being scrutinised by actors outside of the regulator. To my knowledge, very little research has been conducted regarding the exogenous trust relationship between the regulator in an EA environment and the regulated entities. A study of environmental regulation is the closest example of an area in which a similar exogenous trust relationship is portrayed.

The thesis also combines the organisational trust model of Lewicki and Bunker (1996) with a differential trust concept. The concept of differential trust is similar to the model proposed by Lyons (2013) across political institutions. In his study, salient political organisations with high visibility to the public were trusted based on the basis of perceived political and economic performance. This thesis proposes several other trust determinants, including salience, that the regulator uses to determine a level of trust in the EA environment. These trust determinants are part of the tacit calculated concept of trust that the regulator applies to determine a trust relationship. Lewicki and Bunker (1996:10) first define the "calculated conception of trust" as "…the assumption that the decision to trust is predicated primarily on the computation of risks". Although the wording of this concept is similar to Lewicki and Bunker (1996), the exposition of the concept is unique. This study examines the variables that impact this tacit trust calculation in an EA environment and proposes the concept of "differential trust" as the key determinant of the trust calculation. This study goes further by applying innovation as a mechanism to address the sub-optimal decision heuristics encountered by the regulator.

Lange and Gouldson (2010: 5235) state that:

> …the real potential of trust is to open up new ways for participants in regulatory regimes to engage in collective action, to go beyond a perception of regulation as driven by the competing interests of individual actors, and thus, to open up new channels of influence for behavioural change...

In developing an innovative approach to EA regulation, the thesis proposes collaboration with multiple stakeholders as a key mechanism to validate data integrity. This approach would both neutralise the sub-optimal decision heuristic problem as well as positively impact the overall trust calculation. This approach suggests a knowledge-based trust framework for EA regulation to replace the current deterrence-based trust approach. Lange and Gouldson (2010: 5236) conclude that:

> …trust relationships challenges the dominant assumption that environmental regulation is best understood through the lens of social actors' competing, conflicting and potentially irreconcilable interests.

This thesis supports the notion that EA regulation, in addition to environmental regulation, need not be a product of diverse and conflicting interests of actors in the EA environment. There is sufficient data to show that a knowledge-based trust approach to EA regulation, would be supported by the actors in the EA environment. A positive consequence to all parties of such an approach would be the decentralisation of transactional costs associated with the EA process, which in turn decreases costs to all actors. Decreased costs incentivise actors to support the regulatory framework as it is in their self-interest. Incentive-based regulation is considered to be an efficient type of regulatory approach (Bruneau, 2004:538).

There is literature that views regulation as a rent-seeking exercise by government that adds a burden to the cost of doing business (Mueller, 2003; Shleifer, 2005). This research refutes that claim and presents evidence that shows, in an EC equipment environment, that EA regulation is considered crucial in a developing country environment. Even flawed EA regulation was considered better than no regulation.

Another area of the extant literature that this thesis supports is in the field of regulatory theory, particularly the concept of self-regulation. This study suggests a decentralisation of transactional costs in the EA environment, through collaboration with other regulatory entities and test facilities. This approach is essentially a self-declaratory model that is well described in regulatory theory. Gunningham (1995) highlights the importance of external validation of a self-declaratory environment. This research combines the well-defined global standards environment with the ability and reputation of equipment suppliers and test facilities (variables in the trust calculation), to ensure that a high level of trust can be achieved in a self-declaratory environment.

The differential trust concept adopted in this thesis, based on aforementioned reputation and ability of the EC equipment supplier, also supports the literature that suggests that the size of an organisation should be the prime criterion for adopting a trust-based approach. Larger organisations with a good record of compliance are recommended as the best candidates, as the resources available to them allows them to better manage their compliance requirements to regulatory environments (Orts, 1995). The decision to trust an organisation in this study was predicated on the salience and reputational risk that the organisation may face. While the outcome in both studies is the same, i.e. differential trust based on organisational size, the variables used to determine the trust relationship differ.

The final area of academic research that this thesis has contributed to relates to innovation. The diffusion of innovation theory defines how innovation is taken up within a social system and places emphasis on the time taken for the diffusion as well as the communications channels used (Rogers, 2003). This research provides evidence that supports the notion that innovation refers to something that is new to that particular market and not necessarily new to the world (World Bank, 2010). Innovation in the South African market must assimilate technology from other EA environments, although such assimilation must incorporate indigenous variations based on the requirements of the implementing country. The developing country factor is crucial to consider in technology adoption, as technology assimilation was shown to have detrimental effects if a level of circumspection is not applied.

The second aspect of innovation that this research promotes is that of collaboration through validation. This study shows that innovation through collaboration are linked to the calculated concept of trust, as validation is found to be a key determinant of trust.

8.3 Originality

The originality of PhD research can be judged on both content and methodology. Cryer (2006) lists several factors that contribute to "originality" regarding academic research. These factors are used as a guide to demonstrate the originality of this research. This thesis demonstrates originality in: (i) tools, techniques and procedures; (ii) exploring the unknown; (iii) exploring the unanticipated and (iv) originality in the use of data.

i) The grounded theory method of data collection and analysis in studying the EA environment is an original approach. The data collection and analysis process incorporated the Atlas.Ti program as qualitative data analysis tool, in conjunction with the grounded theory method to define the techniques and procedures.

ii) The exploration of an exogenous regulatory view in an EA environment remains largely unexplored. This study combines trust theory and regulatory theory in a unique manner in developing an innovative approach to EA regulation. Linkages between several concepts are shown in developing the substantive theory.

iii) The initial assumption of the theoretical underpinning of the EA regulatory framework in a developing country was primarily centred around public interest theory, the economic theory of regulation and regulatory theory. Trust theory was unanticipated. The analysis of the data led to an in-depth exploration of trust theory in an EA environment.

iv) Analysis of the data resulted in a total of 2507 codes. These codes, subjected to various analytical processes guided by the grounded theory method, resulted in an original, substantive theory of a calculated concept of trust in an EA environment.

8.4 Study limitations

This scope of this research was noted to focus only on South Africa as a developing country. It would be possible to develop a formal theory on an approach to EA regulation by focusing on multiple developing countries and removing any delimitations. This was beyond the scope of this research, and the emphasis was to exclusively to develop a substantive theory on EA in a developing country with a delimitation to South Africa. Using the World Economic Forum (WEF, 2015) categorisation of countries into the developmental stages defined by Porter *et al.* (2002), South Africa was noted as a stage two economy classification that was primarily efficiency-driven. This categorisation was meant to identify the 30 other developing countries in similar stages of development as South Africa. The rationale was that the findings of this study could be generalised across these countries. Data gathered during the research process, however, points to South Africa having many of the first world infrastructure requirements of the EA environment (albeit decentralised and varied in testing capabilities). This limits the generalisability of this research to countries who are both stage two economies as well as EA infrastructure-rich.

8.5 Areas of future research

The structures of trust investigated in this thesis are predominantly exogenously focused as the regulator applies the trust calculation to stakeholders involved in the EA environment. It would be interesting to research an endogenous view, with stakeholders expressing their views on the application of the EA regulatory framework by the regulator. This research collected some initial data from informants in this regard, and further data in this area is warranted. Although research does exist showing a strong relationship between government regulation and trust (Aghion *et al.,*2010), future research should focus primarily on the EA environment.

The third area of potential future research should focus on organisational trust. Schilke and Cook's (2013) work in categories of trust relations is of significance here, as trust in inter-organisational relationships is a key aspect advanced by this research. The rationale inter-organisational collaboration proposed in this thesis is based on remedying the sub-optimal decision heuristic challenge faced by the regulator. In terms of the trust calculation, the regulator should be able to explicitly trust the organisation with which such collaboration occurs before the data from that organisation could be used. This is an interesting dynamic that would be favoured by further research.

This thesis lays the foundation for trust theory to be applied in an EA environment in a developing country. Trust theory is a multidimensional construct, and this research applies it to a narrow domain of EA regulation in a developing country. Future research can build upon this work by first comparing the calculated concept of trust in a developed versus a developing environment and then examining the trust determinants that make up the trust calculation.

8.6 Conclusion

An innovative approach to EA regulation in a developing country is underpinned by a calculated concept of trust applied by the regulator. This trust paradigm is an exogenous one, with the regulator applying a differential level of trust to EC equipment suppliers, based primarily on the salience of the organisation. Trust is the core concept that underpins the EA approach in a developing country such as South Africa. This trust is a product of the sub-optimal decision heuristics experienced by the regulator in South Africa. There are other trust determinants in the calculated concept of trust, including validation through collaboration. Validation of information is a key driver that impacts the trust equation in the EA environment. By collaborating with other entities such as test laboratories and other approval bodies, the regulator has sufficient information to make credible decisions in the EA process. The impact of collaboration is three-fold. The first being the introduction of innovation in the EA environment. By collaborating with other EA entities, innovation adopted in other first world EA environments can be adopted in South Africa. Innovation does not entail a unique approach to EA regulation. The adoption of EA approaches in other jurisdictions also constitutes innovation. The only caveat is that such adoption, especially with regards to standards and technology, should always take into account the developing country conditions. The second impact of collaboration is the decentralisation of transactional costs. With the current approach to EA regulation, ICASA is the central point for submission and payment for EA approvals. A collaborative approach would enable other organisations to either test or approve EC equipment, which could result in cost-savings for the EC equipment supplier as well as introduce efficiencies in the EC process as a consequence of the regulator having a reduced number of EA applications.

The final impact of collaboration is in facilitating knowledge-based trust in the EA process. The regulator is dependent on the information received during the EA process to evaluate conformance to national or international standards. Should a mechanism of verification through collaboration be made available to the regulator, the current deterrence-based trust approach of the EA process will not be required. A knowledge-based trust approach does not entail the threat of a credible sanction as it depends on a trust-based mechanism that can be verified. This theory, therefore, argues that knowledge-based trust can only be facilitated by the calculated concept of trust in an EA environment of a developing country.

South Africa is a net importer of EC equipment and is thus intrinsically intertwined in the global economy. This has a significant impact on the EA approach as the country is compelled to adopt international technology trends and standards. The technological trends in the manufacture of EC equipment have led to a "designed for manufacturability" approach in which evidentiary data required for global EA approval is easily accessible. Deviations from such an approach are, therefore, a difficult proposition, as the global EA approval process is deterministic. Equipment submitted for approval in the global EC market generally results in a binary outcome, with the equipment either being approved or not. Developing countries, therefore, have little control or influence over the global EA process, and the regulator has to make a decision based on the information provided. The calculated concept of trust is thus crucial for the regulator to determine the authenticity of the source of data provided during the EA application process.

Applying technology to the EA process has the added benefit of improving the institutional process efficiency. Ultimately, applying technology and innovation to the EA process has the core purpose of increasing the trust value proposition.

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Appendix A: Interview Guide Version One

Central Question

In which ways can innovative theoretical approaches to regulation be applied to the EA regime of a developing country such as South Africa, in order to address the limitations presented by the current theoretical approaches?

Introductory questions

- Who are the key players in the EA environment?
- What is your involvement in this process?
- What do you think the focus of EA should be?

Sub Questions

- *In which ways does the current theoretical approach to regulation pose challenges to the EA regulatory approach?*
  - Tell me about the current EA process and your involvement in?
  - What, if at all, was your experience in dealing with EA at ICASA?
  - Tell me about your view on EA in terms of its objectives first, then importance?
  - To what extent does the current EA process achieve these objectives?
  - What did you think are the positive aspects of the process and why?
  - What do you think should be the objectives of EA?
  - How has technology impacted on EA?
  - Could you describe the negative aspects of the EA process? Why are these aspects negative?
  - What do you think contributes to these negative aspects?
  - How do you cope with these negative aspects?
  - Does the current EA process support competition?
  - Does the current EA process support innovation?
  - Does the current EA approach support trade?
  - Does the current EA approach facilitate quality EC products?
  - Does the current EA approach protect consumers?
  - How would you describe the current EA regulatory approach (Command and Control vs Self-declaration)?

- How would you describe the current EA approach to standards?
- Does the level of performance in terms of standards in the current EA framework represent an acceptable balance between cost vs harm avoidance?
- Would you consider the current EA framework as being credible and does it provide stability in the EC equipment industry?

- *Why are the characteristics of a developing country unique and how can these characteristics be considered when developing an innovative theoretical approach to regulating EA?*
    - Are there characteristics that are unique to a developing country and what are they?
    - What challenges/problems do you face when involved in the EA process in relation to the developmental state of South Africa? What is the source of these challenges or problems?
    - Are some or all of these challenges applicable worldwide or are they specific to South Africa? If specific, then why do you think that it is specific to South Africa?
    - What contributes to these challenges?
    - How can a balance be struck in order to prioritise the objectives of EA, given South Africa's developmental state?
    - What lessons have you learnt when dealing with the EA process in South Africa? Can you compare it to other countries?
    - How does South Africa's developmental state impact administrative efficiency to EA and why?
    - How does South Africa's developmental state impact trade?
    - How does the state of development of South Africa affect the quality of EC equipment?
    - What does innovation mean to you with regards to EA?
    - How does South Africa's developmental state impact EA innovation?
    - How does South Africa's developmental state impact competition?
    - How does South Africa's developmental state impact consumer protection?

- What level of performance in terms of EA standards would be considered suitable for a developing country?
- How does the state of development of South Africa affect the perception of the credibility of the EA environment and how does this affect the stability of the EC equipment market?

- *How can an innovative theoretical approach be created that addresses the challenges of the current theoretical approach to regulating EA?*
  - What do you think should be the objectives of EA in South Africa?
  - What solutions would you suggest would be best suited to EA in South Africa and why?
  - How would you view (solutions above) versus the previous process in terms of the benefits it could bring?
  - Tell me about your views on innovation in terms of the EA process in the context of South Africa's developing country status?
  - How does it affect innovation in the telecommunications field in general?
  - Describe the EA process and environment in 5 years/ten years given your solutions?
  - Bearing in mind the characteristics of developing countries, please answer the questions that follow.
  - What type of regulatory approach to EA should be implemented in order to drive trade and innovation?
  - What type of approach to EA would maximise administrative efficiency?
  - What type of approach to EA would maximise technical efficiency?
  - What type of approach to EA would maximise EC equipment quality?
  - What type of approach to EA would be the most effective in protecting consumers?
  - Would the approaches suggested above promote competition?
  - What type of standards would be required in order to drive trade and innovation?

- What level of performance in terms of standards should be implemented in the EA process in order to create an adequate balance between cost vs. efficiency given the characteristics of a developing country?
- Is there anything that you may have thought about that I have not covered in this interview?
- Is there anything that you would like to ask me?

Appendix B : Interview Guide Version Two

Central Question

In which ways can innovative theoretical approaches to regulation be applied to the EA regime of a developing country such as South Africa, in order to address the limitations presented by the current theoretical approaches?

Introductory questions

- Who are the key players in the EA environment?
- What, if at all, was your experience in dealing with EA at ICASA?
- Tell me about your view on EA in terms of its objectives first, then importance?
- To what extent does the current EA process achieve these objectives?
- What did you think are the positive aspects of the process and why?
- How has technology impacted on EA?
- Could you describe the negative aspects of the EA process? Why are these aspects negative?
- What do you think contributes to these negative aspects?
- How do you cope with these negative aspects?
- Does the current EA process support competition?
- Does the current EA approach support trade?
- Does the current EA approach facilitate quality EC products?

- How would you describe the current EA approach to standards?
  Does the level of performance in terms of standards in the current EA framework represent an acceptable balance between cost vs harm avoidance?

- ***Why are the characteristics of a developing country unique and how can these characteristics be considered when developing an innovative theoretical approach to regulating EA?***
  - Are there characteristics that are unique to a developing country and what are they?

- What challenges/problems do you face when involved in the EA process in relation to the developmental state of South Africa? What is the source of these challenges or problems?
- Are some or all of these challenges applicable worldwide or are they specific to South Africa? If specific, then why do you think that it is specific to South Africa?
- What lessons have you learnt when dealing with the EA process in South Africa? Can you compare it to other countries?
- How does South Africa's developmental state impact administrative efficiency to EA and why?
- What does innovation mean to you with regards to EA?
- How does South Africa's developmental state impact EA innovation?
- What level of performance in terms of EA standards would be considered suitable for a developing country?

- *How can an innovative theoretical approach be created that addresses the challenges of the current theoretical approach to regulating EA?*

- What solutions would you suggest would be best suited to EA in South Africa and why?
- Is there anything that you may have thought about that I have not covered in this interview?
- Is there anything that you would like to ask me?

Appendix C : List of Documents reviewed

1 The Electronic Communications Act (Act 35 of 2005)

2 Independent Communications Authority of South Africa Act (Act 13 of 2000)

3 The Standards Act (Act No. 29 of 1993)

4 The ICASA Type Approval Regulation (Notice 871 of 2013)

5 The ICASA Revised List of Regulated Standards for technical equipment and electronic communications equipment regulations (Notice 896 of 2015)

6 The ICASA Labelling Regulation (Notice 872 of 2013)

7 Reasons document in respect of type Approval labelling regulations (Notice 882 of 2013)

8 ICASA's Guidelines relating to the type approval framework (Notice 883 of 2013)

9 ICASA Annual report 2006

10 ICASA Annual report 2007

11 ICASA Annual report 2008

12 ICASA Annual report 2009

13 ICASA Annual report 2010

14 ICASA Annual report 2011

15 ICASA Annual report 2012

16 ICASA Annual report 2013

17 ICASA Annual report 2014

18 ICASA Annual report 2015

19 ICASA Annual report 2016

20 ASBIS Complaint 19 July 2016 (email)

21 ITU-D Interoperability and conformity Guidelines 2015

22 ITC Safety Query 30 November 2016 (email)

23 ICASA/SABS MoU signed 3 June 2016

24 Insource TA Query 8 November 2016

25 ICASA Internal Council Submission on the type approval investigation report 11 March 2017

26 Complaints and Compliance Committee Ruling on MASSMART PTY(Ltd) Case 63/2012

27 SAMSA TA Query on Maritime Equipment 11 April 2017

28 TA-2016/1133 ICASA Type Approval application file

29 TA-2016/1134 ICASA Type Approval application file

30 TA-2016/1135 ICASA Type Approval application file

31 TA-2016/1313 ICASA Type Approval application file

32 TA-2016/1312 ICASA Type Approval application file

33 TA-2016/1136 ICASA Type Approval application file

34 TA-2016/1090 ICASA Type Approval application file

35 TA-2016/1089 ICASA Type Approval application file

36 TA-2016/1176 ICASA Type Approval application file

37 TA-2016/1088 ICASA Type Approval application file

38 TA-2016/1091 ICASA Type Approval application file

39 TA-2016/1293 ICASA Type Approval application file

40 Mustek National ICASA Application file 5 May 2016

41 Letter: National Debacle NRCS compliance 4 December 2016

42 Intel TA Request 26 May 2014

43 Vodacom query on TA 11 October 2016

44 ITU Conformity and Interoperability presentation 17 October 2016

45 Favoursea Africa TA Query 2 December 2016

46 2016 IEC CISPR Meeting 24 October 2016

47 Cell-C TA Query 12 April 2016

48 SA/Mozambique Regulators agreement 10 November 2016

49 Nextivity TA Query 13 October 2016

50 Adams & Adams TA complaint 20 June 2016

51 Diopoint TA Query 20 September 2017

52 Reutech Complaint 6 May 2014

53 Dept. of Mineral Resource PowerPoint on TA 31 March 2016

Appendix D: Informed Consent

UNIVERSITY OF THE
WITWATERSRAND,
JOHANNESBURG

1 Jan Smuts Avenue
Braamfontein,
Johannesburg
2000
Phone: 011 717 1000

Participant Information Sheet, Informed Consent Form and Interview Guide

My name is Praneel Ruplal and I am a PhD student conducting research on **"**An Innovative Approach to Regulation of Equipment Authorisation in Developing Countries: A Grounded Theory Study of South Africa". The research report forms part of the requirements for a PhD degree from the University of the Witwatersrand. The purpose of this document is to invite participants to contribute to the research being conducted.

1. Key details

Name	:	Praneel Haricharan Ruplal
St No.	:	9302970J
Degree Title	:	PhD
University	:	University of the Witwatersrand
Thesis Title	:	An Innovative Approach to Regulation of Equipment Authorisation in Developing Countries: A Grounded Theory Study of South Africa

2. Synopsis of the research proposal

This research will try to determine the type and level of regulatory intervention required in the Equipment Authorisation (EA) environment in a developing country. An innovative approach to EA regulation using the South African environment is envisaged as the outcome of this research. This approach will be determined using grounded theory to create a substantive theory of EA regulation.

3. Informed consent

This interview is being conducted as part of the research for a PhD thesis concerned with reviewing the equipment authorisation framework for the electronic communications (EC) sector in South Africa. The research report forms part of the requirements for a PhD degree from the University of the Witwatersrand. I declare that although I am an employee of the Independent Communications

Authority of South Africa (ICASA), this research is solely for academic purposes and does not reflect an official ICASA position. I will be interviewing managers and representatives from equipment suppliers, network operators and industry groups associated with EC equipment. Interviews would be face to face if possible, although Skype or telephonic interviews may also be necessary.

The interview should take approximately an hour to complete.

Anonymity and confidentiality: The results of the study will be published in the Wits electronic library and in scholarly publications, but anonymity will be observed in that the thesis and other publications will not contain material that would identify any particular individual or company. Furthermore, confidentiality will be observed with respect to those responses to any questions, that you would prefer not to be published. With your permission, this interview will be recorded. The recordings will be stored in a password protected file on a password protected computer. The recordings and any notes from this interview will be securely stored, accessible only by the principal investigator on the project. The expected time of completion of the research is July 2018. All recordings will be permanently deleted within two weeks of the successful completion of this degree.

Deciding to participate: If you have any questions about this interview or the broader research of which it is a part, please feel free to ask the interviewer at this time. Your participation is voluntary and you may withdraw from the interview at any time, without giving reasons. To participate, please sign the informed consent form.

Contact details:
Praneel Ruplal
Tel: 011 566 3841
Fax: 011 566 3842
Cell: 0832621057
Email: pruplal@icasa.org.za

Supervisor's Details:

Luci Abrahams

Director: LINK Centre

University of the Witwatersrand

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UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

1 Jan Smuts Avenue
Braamfontein,
Johannesburg
2000
Phone: 011 717 1000

INFORMED CONSENT FORM FOR SIGNATURE: An Innovative Approach to Regulation of Equipment Authorisation in Developing Countries: A Grounded Theory Study of South Africa

Please initial box

1. I confirm that I have read and understand the information sheet for the above study and have had the opportunity to ask questions.

2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving a reason.

3. I understand that the researcher will not identify me by name in any reports using information obtained from this interview and that the private views I express not relevant to this research will remain confidential; **OR**

4. I agree to my name being listed as a participant in this study in the annexure to the report, but not to be referenced in the main body of the report, noting that the private views I express not relevant to this research will remain confidential.

5. I agree to the interview being audio recorded.

6. I agree to the use of anonymised quotes in the dissertation.

7. I agree to be interviewed using Skype (If required)

8. I agree that data gathered from me in this study may be stored

(after it has been anonymised) and may be used for future research.

Name of Research Participant	Date	Signature

Name of Researcher	Date	Signature

Appendix E: Ethics Clearance Certificate

HUMAN RESEARCH ETHICS COMMITTEE (NON-MEDICAL)
R14/49 Ruplal

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER: H15/11/31**
PROJECT TITLE	An innovative approach to regulation of equipment authorisation in developing countries: A grounded theory study of South Africa
INVESTIGATOR(S)	Mr P Ruplal
SCHOOL/DEPARTMENT	Humanities/
DATE CONSIDERED	20 November 2015
DECISION OF THE COMMITTEE	Approved unconditionally
EXPIRY DATE	26 January 2019

DATE 27 January 2016 **CHAIRPERSON** J Knight

(Professor J Knight)

cc: Supervisor : Ms L Abrahams

Appendix F: List of all codes

Name	Count
3rd party assurance providers	1
Ability to assess bottlenecks	1
ability to track applications	1
access to developmental infrastructure	2
access to ICT	1
Access to information limited	3
access to test facilities	6
accessibility	1
Accountability	1
Acknowledgement of bottlenecks	2
Acknowledgement of government inability	1
Acknowledgement of lack of consumer education	2
Acknowledgement of necessity of human element	2
active monitoring	1
ad hoc administrative process	2
adapt international standards for local conditions	6
additional functionality causes problems	2
additional interfaces not tested	1
administration not confined by developmental state	1
adopt international solutions	6
advertise value of ea process	1
Advertised vs. Actual	1
affordability of services	1
affordability of devices	1
affordable prices	2
affordable provision of telecoms	1
align to international standards	5
allocation of resources	1
allow competitive conformance environment	1
allow declaration of conformity	3
allow exemptions	13
allow exemptions to prevent duplication	1
ambivalence towards competition	1
Angry customers	1
applicability to technology to South Africa	1
Apply technology to EA process	9
archaic process	1
Assessed for conformity	1
automation efficient	1
automation for long term	6
automation has helped a lot. t..	1
automation is innovation	1
automation lowers costs	1
automation of ea process	6

automation speeds process	3
automation uses fewer resources	2
automation using a web based system	2
availability of EA staff	7
awareness of regime limitations	1
backlog of applications	1
Backward integration	1
balance between probability of harm	4
Balancing obligations vs. costs	6
benchmark with international r..	1
benefit of EA outweighs cost	1
better communication of process	14
better customs checks required	2
Bill the supplier for testing	1
bribes	2
bridge the digital divide	1
broadband future linked to mobile	1
broadband penetration linked to device	1
broaden economic participation..	1
budgetary constraints	1
build confidence	3
build ICASA brand value	4
build local testing capacity	11
building mutual recognition agreements	4
Built in cost of conformance	1
burden of proof	3
can't water down our standards	16
cannot guarantee confidence	3
cannot guarantee credibility	1
cannot guarantee effectiveness of the EA process	2
cannot outsource ea	1
capture correct information	1
centralised approval system	2
challenges due to low income	1
cheaper accepting test reports	2
cheaper EA process	1
clear process leads to faster approval	1
cognitive radios	1
collaborate to survive	1
collaboration	27
collaboration alleviates frustrations	2
collaboration drives down cost of EA	1
collaboration improves process times	1
collaboration in international standardisation systems	7
collaboration to drive competition	1
collaboration to prevent duplication	3
collaboration with customs	1

collaboration with industry	1
collaboration with other approval systems	10
collaboration with other developing countries	1
collaboration with suppliers	1
collaboration with test labs	11
command and control	4
communication impacts costs	2
communication impacts investment	1
competency	1
competition enhanced in developing country	1
competition	1
competition between licensees	1
competition drives innovation	1
competition drives quality of service	1
competition indirectly based on standards	1
competitive environment	1
complaints delay process further	1
complete loop	1
complexity of consumer protection	1
complexity of EC equipment	1
compliance to standards	2
computer algorithms	1
confidence in system	15
confidence vs time	1
confirming validity	2
confiscation	1
Conformance	2
Conformity (with standards)	5
conformity is a business decision	1
Consistency	1
consultation	2
consumer awareness	6
consumer driven by market forces	1
consumer education	4
consumer education focus	1
consumer protection	15
consumer satisfaction	1
continuous compliance	8
control and command	1
convergence	1
cooperation	1
cooperation between regulator and manufacturer	2
coordinated approach to Ea	1
cost benefit anlysis of standards	1
cost cutting measures	1
cost of authorisation	2
cost of authorisation impacts innovation	1

cost of conformance	10
cost of conformance deters investment	1
cost of conformance impact on established entities	1
cost of conformance key indicator to investment	1
cost of conformance leads to barriers to entry	2
cost of devices impacts replacement time	1
costs passed onto consumer	4
counterfeit equipment	5
country objectives need to be decided	1
create accreditation schemes	1
create category for urgent applications	1
create regional EA body	1
creates a vibrant market	1
creates consumer confidence	2
creating unnecessary burden	1
credibility of test reports	1
credible	0
credible ea process	3
Cross-border coordination	1
cross check information	1
cumulative positive effect of EA	1
Cumbersome	1
Cumbersome process	18
Cumbersome process deters innovation	3
Cumbersome process deters investment	1
current ea process does not drive innovation	5
current EA process manual	4
current inefficient process financially rewarding	1
customer at end of value chain	2
customs and excise control equipment entry	4
Data monitoring in place	1
Day to day struggle	1
declaration of conformity	1
decrease costs	4
delay in deploying new technology	2
delays	15
delays impact trade	4
delays protect monopoly	1
delegating ea function	1
demand for mobile	1
demonstrate capability to industry to ensure compliance	1
denying responsibility?	1
deregulation	2
design standards limit innovation	1
develop verification mechanism	4
developed country different environment	2
developed country differentiated features of ec equipment	1

developed country level of trust	3
developing countries are price sensitive	1
developing country counterfeit equipment	2
Developing country no hindrance	2
developing country problems generalisable	7
developing country should have high growth	1
development state does not affect administrative efficiency	1
development state does not affect trade	1
developmental challenges drive innovation	1
difference in objectives vs reality	1
differentiated level of standards	1
differentiation between different suppliers	25
differentiation between suppliers EA fees	2
Differentiation of application complexity	1
Differentiation of company ea fee	1
Differentiation of comparison (Developed vs. Developing)	2
Differentiation of subsidies w.r.t. company size	1
difficult to duplicate testing facilities	1
difficulty in gauging success of EA	1
difficulty of defining types of technology	1
digital divide	1
Digital Dividend	1
digital literacy	1
Digital Migration	3
digital society	1
disruptive technology	2
does the regulator possess requisite technical skills	3
Double jeopardy	1
dual role of network operators	2
dupicate approvals	3
duplicate approvals	5
duplication of approval process	16
duplication of resources	9
dynamic industry	1
e-waste issue	1
EA about getting products to market	1
EA adds to cost structure	4
EA administration requires people	1
EA administration requirements gotten worse	4
ea agnostic to trade	2
ea approach incorrect	2
ea barrier to entry	3
EA based on standards	2
ea can promote competition	5
EA certificate lacking info	1
EA certification lacks information	1
ea cost not prohibitive	3

EA crucial to business continuity	1
EA databased required	6
ea delays speed to market	6
ea delivers quality	11
ea does not achieve objectives	1
ea does not guarantee confidence	2
ea does not guarantee quality	1
ea does not hinder innovation	1
ea drives innovation	2
EA enforcement support lacking	1
EA enhances device coordination	1
EA essential to promote competition	1
EA evaluation is technical based	3
Ea favours larger suppliers	2
EA growth linked to tax increase	1
ea has no impact on consumer protection	1
ea hinders business	2
ea hinders innovation	7
EA impacts cost benefit analysis of trade	1
EA impacts cyber security	1
EA impacts trade	1
EA implies quality	1
ea inflexible	2
ea inhibits local manufacturing	1
EA instills confidence	6
ea is a specialised skill	1
EA is region specific	2
EA legislative scope too broad	4
ea limits sub-standard equipment	2
EA money making scheme	1
EA mostly effective	1
EA must aim to reduce costs	2
ea must be transparent	1
ea must instil confidence in the product	1
EA must keep up with technology	1
EA must support local markets	2
EA needed in developing countries	1
EA needed in SA	1
ea not a catch all process	1
EA not keeping up with technology	11
EA not obstacle to trade	2
EA not seen as competitive advantage	1
EA obstacle to trade	4
EA ownership misplaced	1
EA prevents dumping	2
EA prevents grey market	1
EA prevents interference	3

EA problems self made	1
ea process deters investment	1
ea process clearly defined	2
EA process difficult	6
EA process does not guarantee functionality	2
EA process encourages illegal equipment sales	3
EA process includes lab verification	1
EA process inspires consumer confidence	1
ea process is sound	5
EA process limited to mandatory requirements	2
ea process not clear	4
EA process not well documented	4
EA process paper based	6
ea process requires review	8
ea process serves as a deterrent to investment	1
ea process still key in the future	2
EA process varies	1
EA process works	4
ea promotes competition	1
EA promotes QoS	1
EA promotes trade	1
EA protects supplier	1
ea provide accessibility for disabled	1
Ea public interest objectives	10
EA required for future broadband technology	1
EA revenue generating exercise	2
EA rubber stamping exercise	4
EA sampling methodology	1
ea should level playing field	1
EA should not support competition	2
EA significant impact on economy	1
ea stifles competition	4
Ea suppliers always local	1
EA supports competition	8
ea supports consumer protection	3
ea supports illegal equipment	1
ea supports trade	7
ea theoretical exercise	1
EA visibility not enough	2
ea vitally important	10
ease of EA process	1
easing the conducting of business	1
EC market driven by economies of scale	1
EC market multi-disciplinary problem	1
EC products match market	3
economic growth	1
economic value	1

economic cost of delays	8
economic growth	2
economic impact of policy failure	1
economic role	1
economic value of spectrum	1
economies of scale	8
education challenges	1
effective competition	2
effective management	1
Effectiveness	1
efficient management	1
efficient spectrum usage	1
efficient collection of revenue	1
Efficient EA process	7
Efficient use	0
Efficient use of resources	2
efficient use of this crucial ..	1
encourage foreign investment	1
encourage new technologies	1
encouraging effective competition	1
Encouraging investment	2
end user perspective	1
enforcement	12
enforcement will impact quality	1
enforcing compliance	1
engagement	2
engagement with regulator required	1
ensure compliance	1
ensure safety	1
equipment life cycle very fast	2
exemptions allow streamlining of EA process	6
experience in testing	1
exploit developing country resources	1
Extending testing facilities to include regional	2
facilitate greater choice	1
facilities for smaller suppliers	1
facilitates trade	2
fair prices	1
fertile ground for competition	1
finite national resource	1
financially constrained	4
fines for non-compliance	1
First come first served approach	1
first mover advantage	4
First world standards	4
Flexibility for EA process required	4
flexibility in interpretation	3

focus of research and development	1
focus on consumer	12
focus on CPE	1
focus on ease of conformance	3
focus on enforcement	14
Focus on exemptions	6
focus on functional requirements	14
focus on imports	2
focus on improving confidence levels	1
focus on interference	16
focus on interoperability	8
focus on mandatory standards	3
focus on operation of device	2
focus on quality	5
focus on safety	15
Focus on transmitting equipment	1
Follows the "official line"	1
forging test reports	3
fragmented regional harmonisation	2
frequency sharing	2
from a manufactures perspective	1
frustration	1
Functional overload	1
functionality	3
funds for ICASA	1
future EA as an enabler	1
future EA as an enabler of trade	2
future EA environment contributing to economy	1
future enabling EA environment	1
future focus on strong post market surveillance	6
global competitor	1
global skills	1
golden sample problem	11
governmental collaboration	5
governmental intervention	2
governmental intervention & policies to address developmental challenges	5
governmental subsidies	6
governmental subsidies for local manufacturers	2
governmental support required	1
grey market a problem	4
grey market interference	2
grey market more prevalent in developing countries	1
grey market remains	2
grounds for exemptions	3
guidance and communication required	2
guidelines	1

handset subsidies	1
harmonised approach required	2
health challenges	1
Health related focus	1
high-quality communication	1
high cost of ICT services	1
high cost of test facilities	4
high cost of testing	3
High Demand Spectrum	1
high EA cost	1
high fines for non-compliance	1
High integrity of network	1
high labour costs	1
high level of innovation in SA	1
High level of retailer sensitivity	1
high level of trust	1
high levels of investment in standards	1
high manufacturing costs	1
high quality communication	1
high unemployment rate	1
higher state development negates need for EA	1
hiring correct skills	3
hybrid EA solution	3
ICASA EA national focus	1
ICASA should be decisive	1
ICASA standards scope limited	1
ICT budget declining	1
ICT budget dictated by developmental priorities	2
ICTs neglected in SA	1
illegal equipment	6
illegal equipment remains	3
illegal frequency use	1
illegal operations	1
immaturity of market	1
impact of standard on industry not quantified	1
implement market surveillance	1
importance of accreditation bodies	1
imports exclude intellectual capital	1
imports impact local manufacturing	1
imports inhibit innovation	4
improve confidence level	4
improving the administrative, ..	1
In-line with international standards	4
inconsistent approach to requirements	1
increase efficiency of EA	1
increase scope of testing	3
Increased administration for conformity	4

increased number of suppliers	1
increased time to market	5
Increasing turn-around times	7
incremental improvement	3
indicating conformance issues	2
industry frustration	2
Ineffective post market surveillance	8
Inefficiency	3
Inefficiency creates opportunities	2
Inefficiency in the process	7
inefficient use of resources	1
inequitable skill levels	1
inferior products	1
information asymmetry	1
Information supports enforcement	2
informational deficiency	7
infrastructure sharing	1
inherent positive ability in current system	2
inhibits innovation	3
innovate on current process	5
innovation	1
innovation affects efficiency	2
innovation based on international best practise	2
innovation boon to consumer	1
innovation driven by market	1
innovation drives volumes	1
innovation higher in developing country	2
innovation linked to process	1
innovation makes things cheaper for consumer	1
innovation makes things easier for the consumer	1
innovation not local	2
innovation related to effectiveness	2
innovation via collaboration	3
innovative competition	1
Integrity	2
intention of the EA process sound	1
interference	2
interference mitigation	11
interference resolution	3
internal coordination	2
international best practice	8
international collaboration	4
Interoperability	7
introduce competition	1
investing in research and development	3
investment	1
investment in testing equipment	1

investment in testing equipment business proposition	1
irate customers	1
Is it a revenue generating exe..	1
ITU support to set up conformance and interoperability facilities	1
job creation	1
justify spending on ICTs	1
Keep up with 1st world	1
Keeping control	1
knowledge-based economy	1
labour intensive process	3
Lack of adequate number of staff for EA	9
lack of automation	6
lack of communication	19
lack of confidence in certain test labs	4
lack of confidence in products	1
Lack of consultation	1
lack of consumer activism	5
lack of consumer education	4
lack of cross border EA integration	1
Lack of e-resources	1
lack of exemptions	1
lack of expertise	1
lack of exports of EC equipment	1
Lack of facilities for verification	29
lack of funds	1
lack of funds for R&D	1
lack of funds for standardisation activities	1
lack of hierarchy in determining importance	1
lack of industrial development	1
lack of information	12
Lack of international standards participation	2
lack of local manufacturing	4
lack of local test facilities	19
lack of local vendors	1
lack of mechanism to verify	2
lack of policy support	2
Lack of punitive measures	2
lack of quality	1
Lack of regional mutual recognition of EA	4
lack of regulatory enforcement	2
Lack of resources	18
lack of service delivery	1
lack of skills to be a global competitor	3
Lack of support	1
Lack of trust with suppliers	19
lack of understanding	10
lack of verification	4

language barrier	1
large backlogs	1
leap frog legacy technology	1
legal framework	1
legal framework problematic	2
less focus on consumer protection	1
less interventionist approach	2
level of standard must suit market	1
level of standards impacts costs	4
level of trust	1
leverage on existing resources	4
liability of supplier	1
light licensing regime	3
Limit efficiency of system	2
Limit harmful effects	1
limited mechanism of EA approval in SA	1
limited pool of EA skills	7
limited post market testing	5
limited window of opportunity	1
linear process on standards conformance	1
literacy levels	1
Local collaboration	3
local conditions not considered	1
local development generates revenue	1
Local market for low cost devices	1
Local market for testing devices exists	1
local market impacts economy	2
Local market linked to job creation	2
local standards development framework	2
local test capacity	3
local test capacity driven by demand	1
local test capacity limited	1
local testing a duplication	3
local testing essential	3
local testing highlights deficiencies of internationally approved products	1
local testing regressive	1
long training times	1
long turn around times	15
Low confidence in process	8
low literacy inhibits innovation	1
low power	1
Lower costs	7
lower volumes	1
maintain standards at a global level	3
maintaining control	1
making a contribution	1
manufacturing will support GDP	1

market for counterfeit devices	4
market for low cost products	2
market forces determine price	2
market predominantly rich manufacturers	1
market should drive standards	1
market stability vs credibility	1
Measures of recourse	1
method of conformance	1
minimise duplication of resources	1
Misplaced confidence?	1
mixing standards regimes with EA regimes	1
mobile gained traction	1
modular approval	3
move burden of proof	1
multi governmental approach to tackle developmental challenges	1
national radio frequency plan	1
Necessity	1
need to be competitive in world market	1
need to improve confidence level	2
network operator conducts own testing	4
network operator not always a vendor	1
network protection	8
no brand value	1
No compromise on objectives	7
No compromise on objectives of EA	5
no compromise on quality	4
No compromise on safety	3
No consistency when dealing with applications	1
no consumer confidence	1
no deviation for specialised cases	1
no differentiation in products	9
no differentiation w.r.t. enforcement of suppliers	1
no evidence of faulty equipment	1
no exemptions	1
No feedback verification mechanism for market surveillance	1
no independent verification	2
no local compliance testing	3
No market for local test facility	1
no need for local test facility	2
no proper system in place	2
no quality standards	1
no trust with smaller suppliers	2
non-discriminatory approach	1
not labour intensive process	1
objective to remove barriers to trade	2
Objectives of EA	3
Objectives of EA efficiency	1

objectives of the process is sound	2
obsolete equipment in SA	2
OEM reputation	6
one way trade	1
online applications	5
open international standards	2
open standards drive competition	1
open standards drive innovation	1
Opening up markets	2
operators check quality independent to EA	2
opportunity costs	1
optimise radio frequency	1
Optimising resources	1
Other regulatory bodies	1
output standards	1
outsource EA function	2
over-haul required	1
pace of technology	5
partial testing	2
peer review of standards	1
perpetuate digital divide	1
policies to build skills and capacity	4
policy intervention	4
policy to drive development	2
political landscape hinders growth	1
politics contributes to developmental challenges	1
poor admin staff support	3
Poor IT support	1
poor policy intervention	2
porous border points of entry	1
post market sample testing required	7
Potential to cause harm	1
poverty	1
PPP (Public Private partnerships)	3
PPP (Public Private partnerships) mutual benefit	2
precedent set for regulatory exemptions	2
predictability	2
predictable regulatory environ..	2
predominantly imports	9
prevent bottlenecks	2
prevent dumping	11
prevent duplication	17
prevent harmful effects	5
prevents competition	1
price determines quality	2
price hurdle of equipment	1
price inelasticity of smaller suppliers	1

priority to larger developmental challenges	3
problems accrediting test facilities	1
problems similar to developed countries	2
problems with collaboration	2
problems with labelling	1
procedure for unique approvals	1
Process improvement	6
process improvement innovation	1
process straight-forward to technical people	1
processing time improvement	5
Processing time too long	10
product innovation	1
profit goal of private company	1
progress noted but not enough	1
prohibits self-declaration	2
promote competition	2
promote efficiency	1
promote innovation	1
promote local manufacturing	5
promote local market	1
promote transparency	1
promoting competition	1
Proportion of compliance cost vs. company size	1
Proportionality	1
protect consumer	1
protect consumers	1
protect smaller suppliers	1
Protect the consumer	2
protection of consumers	1
protection of scare resources	1
provision of broadband service..	2
public consultation	1
public education and awareness..	2
public interest	17
quality	8
quality consumer choice	5
quality of electronic communication	1
quality of service	1
quality of service vs device quality	1
quality related to standards	2
Quest for efficiency	1
questioning need for EA vs. technology	1
quicker	1
quicker EA process decreases costs	1
quicker response times	2
quicker time to market	11
rapid technology development	4

reactive rather than proactive	5
real time response	1
realistic about requirements	4
realistic verification required	2
reasonable certainty	2
record keeping	1
red tape	3
Reducing regulatory burden	5
reduction in prices	1
regional harmonisation	1
regional trade not facilitated	2
regional trade organisation framework exists	3
Regional trust	1
regulation must facilitate technology	1
regulation to facilitate service	1
regulations inflexible	2
regulator doing well	2
regulatory framework for EA not updated	3
regulatory framework for EA too broad	3
regulatory framework not quick enough	2
regulatory importance	3
relax command and control	1
relaxing means more control	1
relevance of EA	1
reliance of test results	3
remove barriers to entry	4
Require more experts	1
requirement to compete internationally	1
research and development lacking	7
Respect for ICASA approval	4
reversal of objectives of EA	1
revolutionise industrialisation	1
RF coordination	4
RIA for EA regulations	1
rigidity in EA regimes	1
rigour in EA process	1
risk accepting test reports	2
Risk of dumping	2
SA not unique	7
SA blend of 1st and 3rd world	2
SA EA accepted within SADC	1
SA fully inclusive of world economy	1
SA has adequate skills	5
SA is a small market	5
SA lagging behind on technology	1
SA leader in SADC	6
SA many ports of entry	1

SA missed opportunity for lab	1
SA net importer of equipment	5
SA not really a developing country	2
SA participates in International standardisation	1
SA significant EC equipment market	1
SA technology on par with world	4
SA unique	8
SABS issues all test reports	1
safe to use	1
safety	3
sanctions required for non-conformance	1
SAR exposure	1
scrap current EA process	1
Self-correcting technology	2
self-declaration	4
self-declaration to drive innovation	1
self-declaration will drive trade	1
self-manage	2
self-optimise	1
self-regulate	3
Self-regulation	3
set high standards	4
sharing technology	3
simplicity is innovation	1
simplified process	4
skills development lacking	5
skills transfer from industry to regulator	1
slow economic growth	1
small local market	6
social and economic goals	1
social development	1
socio-economic and development..	1
socio-economic objectives	3
soft touch approach	1
some EA only impact network operator	2
Some SADC countries do not require EA	1
spectrum efficiency	1
spectrum issues	7
spectrum scare resource	1
speed of EA process	3
stability	1
Stakeholder relations	1
standards bodies key	2
standards developed via balanced representation	1
standards developed via consensus	1
standards drive economies of scale	3
standards embedded in regulation	3

standards impact not considered	1
standards process too long	4
standards regulation living document	2
standards very important	5
streamline EA process	6
stringent future penalties for non-compliance	2
strong monitoring	1
Structure of enforcement lacking	4
structured way of engagement	1
supplier registration	1
Supplier reputation	3
suppliers conduct own testing	1
support structures for EA	1
support to smaller suppliers	4
technical training for EA staff	2
technical understanding lacking from suppliers	2
technological advances	1
technological colony	3
technological development	1
technology advancement increases cost of conformance	2
technology allows equipment self-regulation	1
technology because of Standard..	3
technology commoditised	3
Technology convergence	4
technology depends on environment	1
technology drives demand	2
technology drives volumes	5
technology has not impacted EA.	1
Technology highlights deficiencies of EA	4
technology impacts EA processing time	1
technology impacts markets and equipment suppliers	2
technology impacts radio protection	2
Technology Intelligence	4
technology makes EA cumbersome	3
technology makes equipment cheaper	1
Technology neutrality	1
Technology overtakes regulation	9
technology overtakes standards	5
technology puts pressure on the regulator	3
technology reduces complexity of test equipment	2
Technology renders EA objectives moot	2
Technology to improve efficiency	2
test facilities	3
test facilities not an issue	2
test functionality only	5
test labs exist	2
Test reports difficult to get hold off	3

testing capacity expanded regionally	2
testing costs too high	2
testing expensive	5
Testing now automated vs manual	1
time	1
time is money	9
time to market crucial investment indicator	3
time vs efficiency	1
too many standards required to prove conformity	3
transformative country	1
transparency	5
transparent	1
transparent regulation	1
Treat EA as business case	1
trust	20
trust in the EA process limited	3
trust matrix	1
trust with labs	5
trust with OEMS	6
trust with operators	2
trust with other countries	1
trust with suppliers	7
turn-around times too long	4
two tier approach to functionality	1
underserved areas	1
understanding process	6
universal access and service	1
universal service and access	1
unprofessional administration	1
unscrupulous retail practices	1
Unseen costs	1
urban and rural split.	1
use international best practice	3
use interns for capacity building	1
user-friendly	2
using ea as a competitive advantage	1
using standards as a competitive advantage	1
validity of EA never ceases	1
value in the fact that at least process exists	1
value of current EA technical process	8
value of standards not interrogated	1
vendors compromise quality to lower costs	1
Verification limited to functional requirements	2
volume of approvals impact productivity	9
waste of resources	1
well-capacitated consumer protection	1
wireless technology for broadband penetration	2

wireless technology is future	1
working regime	1