Towards an adaptive socio-technical Broadband Growth and Penetration (BGP) framework: A case of SADC.

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Thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy (Information Systems) at the Mafikeng Campus of the North-West University

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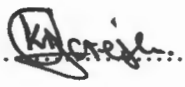
DECLARATION

I do here by declare that

Towards An Adaptive Socio-Technical Broadband Growth and Penetration (BGP) Framework: A case of SADC

is my work and hereby present it for the degree of Doctor of Philosophy in Information Systems at the North West University, South Africa. This work has not been submitted to any university or educational institution before for examination. All materials consulted have been duly acknowledged through referencing.



Karikoga Gorejena

DEDICATION

I dedicate this work to all the 3rd World people of all ethnic backgrounds whose potential has not been maximised and whose dreams became a nightmare due to the unforgiving circumstances around their birthplaces. I also dedicate this work to my late parents Mr O. and Mrs K. Gorejena. To Clara Mauwa, Ruth, Prince and Daniel Gorejena.

ACKNOWLEDGEMENTS

I would like to acknowledge God Almighty for enabling me to live beyond human ability and for insightful nuggets captured in this work. Thanks Dad. My graceful gratitude goes to my promoters, Prof N. Mavetera and Dr M. Velempini for your patience with me and your unwavering support throughout this work. Prof Mavetera thank you for your candour and brotherly engagements. Dr Velempini, your attention to detail was immaculate, I will always treasure your rigor. Gentlemen, only God can reward you. To all Information Systems department crew, thank you for your genuine support and understanding. You mean a lot to me. I want to thank my dean of faculty of Commerce and Administration for your financial support and personal encouragement during this project, may the Lord bless you.

My greatest appreciated to NWU bursaries, ADC support and many more who unconsciously contributed to the success of this project. Clara Mauwa, you have always believed in me and your steadfast love and support has seen me through this work. Ruth, Prince and Daniel you are God's masterpieces, may you carry His Presence to your generation. You have been a silent but sure inspiration.

ABSTRACT

The transformative benefits of broadband on economic and social variables have led governments to set ambitious targets for its deployment. In making a case for public policy on broadband, many studies have sought to identify and measure broadband economic benefits. The everyday benefits of broadband cannot be overemphasised; in the medical fraternity remote and complex surgical operations are carried out by robots via satellites, executives are empowered to make decisions and access new opportunities through online information and the list is endless. In an increasingly integrated global economy, broadband is central in providing economic growth and competitiveness to any organisation, country or region.

On a world scale SADC countries rank among some of those with lowest broadband growth and penetration. This phenomenon has its roots in the frameworks being used to promote broadband growth and adoption among other things in these member states.

This research argues that traditional broadband frameworks used across the world are quite similar in their design though they may be implemented differently. The research used a few examples to illustrate this. As a point of departure, this research submits that broadband frameworks may share similar structures but these structures need to be permeated and influenced by the uniqueness of the people group among which they intend to be implemented. As a result, each framework needs to reflect a certain degree of this uniqueness both in structure and implementation.

Using Socio-Technical Theory (STT) as a lens, this constructive research task aims to propose a framework for enhancing broadband growth and penetration in SADC. The research seeks to present an evolutionary and adaptive framework for broadband growth and penetration by analysing and integrating the major determinants in our reality space which are Society, Technology and their Environment. This Socio-technical environment was studied in bid to establish the relationships that exist and should exist between the mentioned determinants. The resulting framework articulated principles that should underpin and guide efforts of task teams and/or governments as they thrive to achieve broadband growth and penetration within the region.

The outcome of this research is an evolutionary and adaptive broadband growth and penetration framework. The framework will also serve as a guide for future models applicable to an

information society where broadband is viewed as a vehicle for globalisation and national to regional competitiveness.

The outcome of this research which is a socially constructed artefact; a framework for broadband growth and penetration in SADC was tested using focus groups comprising IT experts.

In the interest of smooth understanding of this study it is expedient to define key and technical terms which are frequently used in this document.

LIST OF ACADEMIC OUTPUTS FROM THIS STUDY

Gorejena, K., Mavetera, N. & Velempini, M., 2014, "Towards An Adaptive Socio-Technical Broadband Growth And Penetration (BGP) Framework: A Case Of SADC", *Crafting Global Competitive Economies: 2020 Vision Strategic Planning & Smart Implementation ISBN: 978-0-9860419-3-8 (Proceedings)*

Gorejena, K., Mavetera, N. & Velempini, M., 2016 "A critique and potency of socio-technical systems theory: A quest for broadband growth and penetration" *Public and Municipal Finance, Volume 5, Issue 2, 2016*

Gorejena, K., Mavetera, N. & Velempini, M., 2016 "A framework for dealing with the complexities of a Socio-Technical environment: A case of South African broadband." *World Multi-Conference on Systemics, Cybernetics and Informatics 2016 (Proceedings)*

Gorejena, K., Mavetera, N. & Velempini, M., 2014 "The efficacy of mixed methods: a case of SADC broadband growth and penetration" *International Journal of Innovation Management (World Scientific) (Submitted)*

Research Proposal Colloquium (NWU) 2014

Methodology Colloquium (NWU) 2015

Results Colloquium (NWU) 2016

DEFINITION OF KEY TERMS AS USED IN THIS RESEARCH

Broadband: broadband does not have a single, standardised definition. Definitions based on data transfer speed are not able to take into account the very fast evolution in technologies and uses. Is a bandwidth of 256 kbit/s a broadband connection? Should the lower limit be set to 1 Mbit/s? There is no definitive answer as the bandwidth required to run internet applications is continuously increasing and infrastructure standards are also continuously improving to face the growing demand. Such a definition can only be relative to a particular moment in time in a particular country (EU 2008). The term "broadband" may refer to multiple aspects of the network and services, including: 1) the infrastructure used to deliver services to users; 2) high-speed access to the Internet; and/or 3) the services and applications available via broadband networks, such as Internet protocol television (IPTV) and voice services that may be bundled in a "triple play" package (one in which video, voice and data are provided for in a single access subscription) with broadband Internet access. Further, each country has its own definition of broadband based on speed, typically in Mbit/s or kilobits per second (kbit/s), or based on the types of services and applications that can be used over a broadband network (i.e., functionality). Due to each country's unique needs and history, including economic, geographic and regulatory factors, definitions of broadband vary widely. (World Bank 2012)

Definition of Broadband for Southern African Development Community (SADC): In SADC broadband is defined as an always available, multimedia capable interactive network connection with characteristics, as determined by Ministerial Policy and published in Regulations by the Authority from time to time (National Broadband Policy 2013)

This research uses as a working definition of broadband as the provision of telecommunications infrastructure that enables information traffic in a continuous and uninterrupted manner, with sufficient capacity to provide access to data, voice and video applications that are common or socially relevant to users as determined by the SADC from time to time (WB 2012)

Broadband Growth and Penetration (BGP) Framework: The BGP Framework comprises overarching principles, procedures and guidelines used for promoting broadband growth and penetration. **The purpose of the BGP framework** is to articulate principles that underpin all

activities relating to promoting broadband growth and penetration giving room for a constant review of these activities. (Adapted from University College Dublin 2014)

Policy: A principle or protocol to guide decisions and achieve rational outcomes. It is a statement of intent, and is implemented as a procedure or protocol (Wikipedia c.2014)

Broadband Growth: The extent to which broadband infrastructure has reached, geographically.

Broadband Penetration: According to wiseGEEK (n.d) the term "broadband penetration" refers to the amount of the Internet access market that broadband internet has captured.

Competitiveness: pertains to the ability and performance of a firm, sub-sector or country to sell and supply goods and services in a given market, in relation to the ability and performance of other firms, sub-sectors or countries in the same market (World Economic Forum 2010)

Globalisation (or **globalisation**) is the process of international integration arising from the interchange of world views, products, ideas, and other aspects of culture (The Levin Institute 2014)

SADC: Southern African development Community- a fifteen member states community in southern Africa.

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CHAPTER 1: INTRODUCTION TO THE RESEARCH

Towards An Adaptive Socio-Technical Broadband Growth and Penetration (BGP) Framework: A Case of SADC.

1.1: Background to the Research Problem

The following discussion focuses on broadband growth and penetration in SADC in the last seven years. Analysis given by other scholars and professional bodies on SADC broadband state is brought to light. More importantly this section examines the SADC broadband framework and compares it with the American one and the recommendation given by the World Bank on broadband policies. Based on these frameworks parallels were drawn. Then recent academic literature on broadband is briefly analysed in light of what's missing. Finally a brief highlight of what this research intends to do differently in its proposed framework for SADC is outlined.

SADC's main focus is on infrastructural development of the six main pillars supported by the blocks of Human Capacity and Awareness development and the Legal and Regulatory framework as shown below:

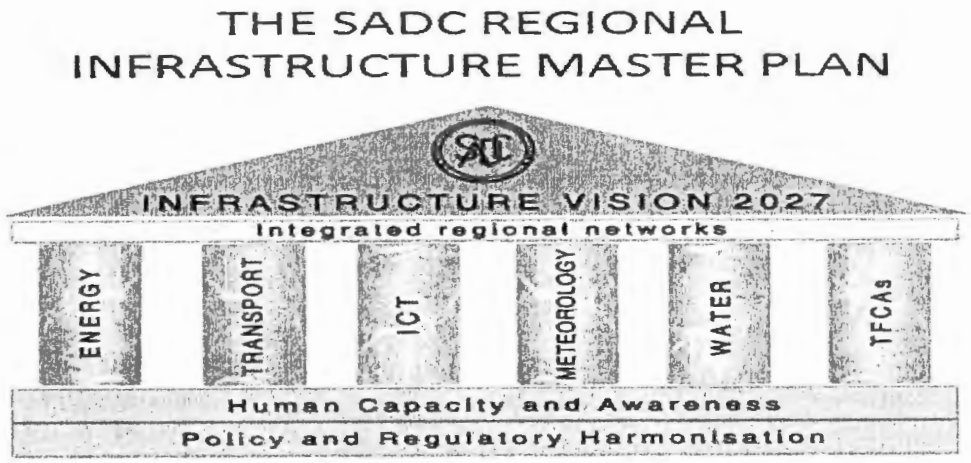


Fig 1.1 SADC Regional Infrastructure Master Plan (SATA 2014)

It is in this context that ICT as one of the pillars of regional development is addressed by a specific implementation agency Southern African Telecommunications Association (SATA).

The aim of SATA is "to develop Telecommunications and ICT networks and services of a regional nature that are responsive to the diverse needs of commerce and industry in support of the regional socioeconomic development programs. To achieve this mission, SATA is implementing several projects and initiatives through its Membership, including human capacity development programs." (SATA 2014). Right from its aim one can identify some of the components that make up a framework which informs SATA namely; Hard infrastructure, Services and Human capacity development.

According to SADC Infrastructure Development Report for Council and Summit (2009), the following achievements have been made: common framework for legislation and regulation, the establishment of "e-SADC" which is meant to take advantage of ICT to achieve socio-economic development, participation of private sector in the ICT market, arrangement for SADC to immigrate from analogue to digital by the end of 2013 and full liberalization of the markets.

Notwithstanding these successes by SADC in the telecommunications sector, the facts and figures on the ground with regards broadband penetration in SADC reflect a different reality as shown by the following illustration:

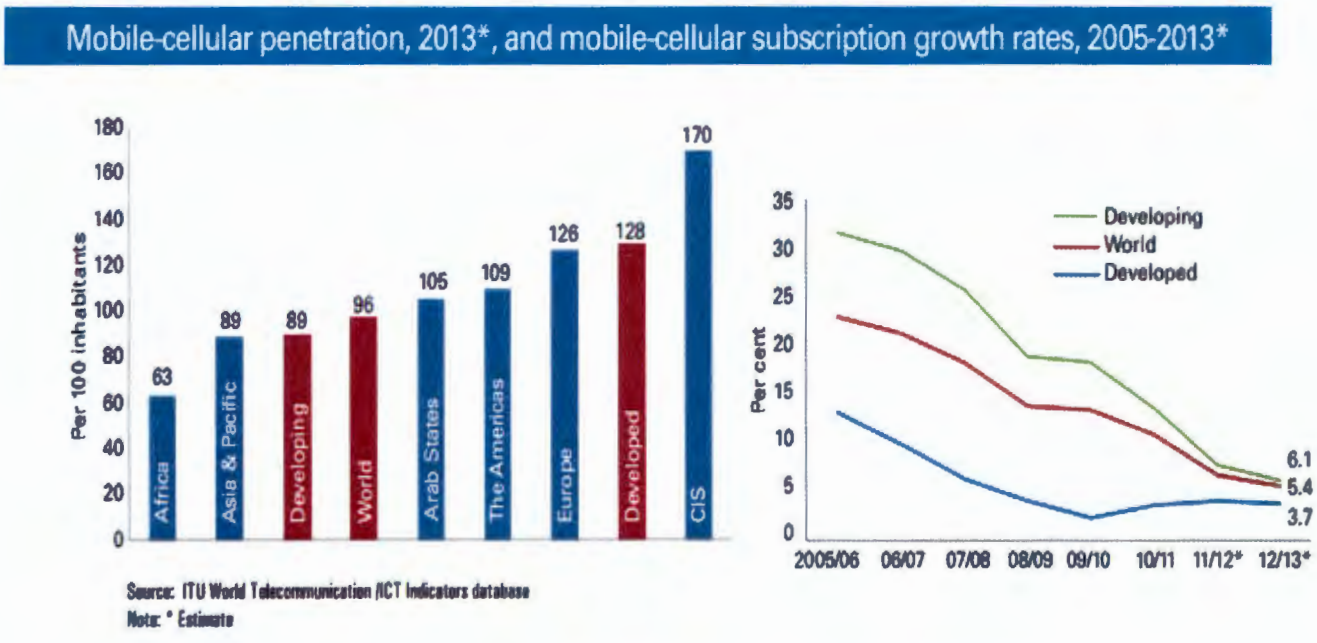


Fig 1.2: Mobile-cellular Penetration and Growth rates (ITU 2013).

The first graph of Fig 1.2 indicates that Africa is the least in terms of mobile cellular penetration and this translates directly into SADC's poor penetration globally. The second graph of Fig 1.2 shows that even though there has been an increase in mobile subscriptions over time the rate of growth has decreased, even more rapidly in developing nations like in Africa. Both the developed and the developing nations are fast reaching saturation of their markets but for entirely different reasons.

The constant value of mobile subscription approached by developing economies does not immanent from the cause as that for the developed world. In the developed world, this is due to market saturation whereas in Africa and it is mostly due to high pricing which leads to a small catchment market and this market fast got saturated (Esselaar & Gillwald 2007). This research suggests that apart from monopoly and pricing of broadband, there are other latent factors of intricate relationships that affect broadband uptake in Africa particularly. For easy comparison with the rest of Africa and the entire world, the following illustration shows SADC's mobile subscription:

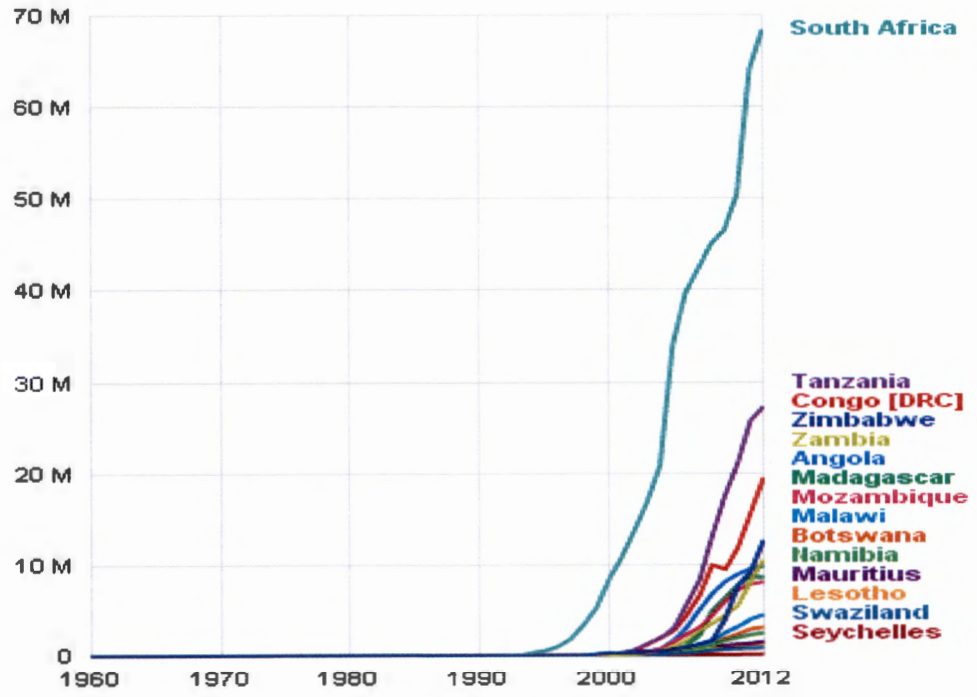


Fig 1.3: SADC Mobile Subscription (SATA 2013).

Hypothetically, adding all the persons in millions on the y-axis for each member state and comparing the total with the world population of about 7.1 billion, would reveal that SADC and analogically Africa has significantly a small number of mobile subscribers on world stage.

In the following section, the researcher is going to critique the broadband framework used by SADC and compare it with that of the United State of America and European Union. The gap in these frameworks was discussed and a proposed framework for SADC was be given.

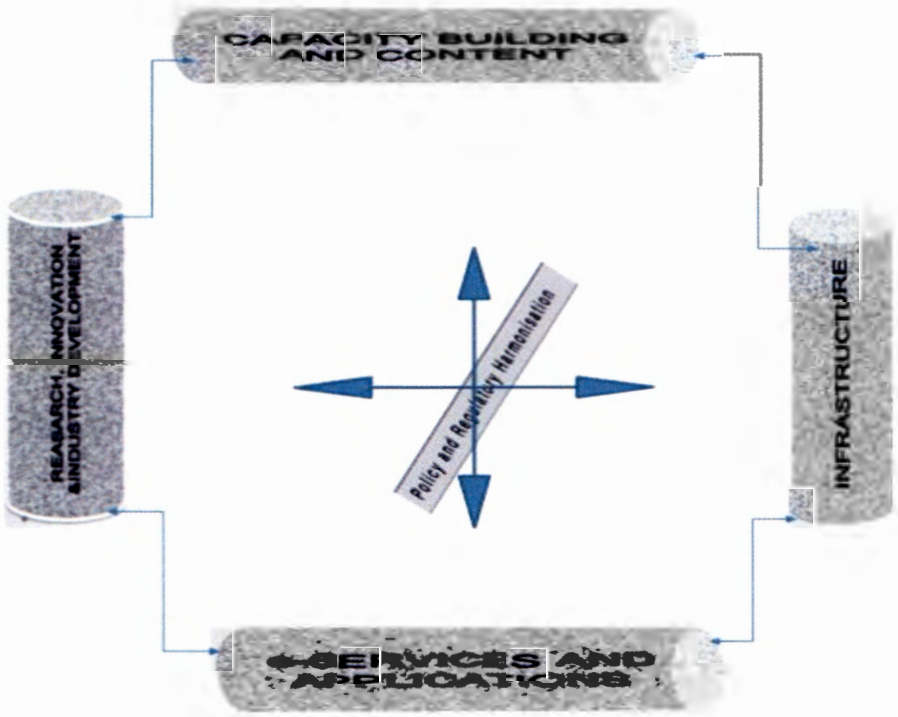


Fig 1.4: SADC Broadband Framework (SATA 2013)

According to SATA (2014), the subsystems of its broadband framework above are each responsible for specific functions as articulated below:

Research, Innovation and Industry Development: Development of ICT equipment manufacturing, software and applications. Collaboration and knowledge sharing between research centres.

Capacity Building and Content: Broadcasting and universal ICT education programme.

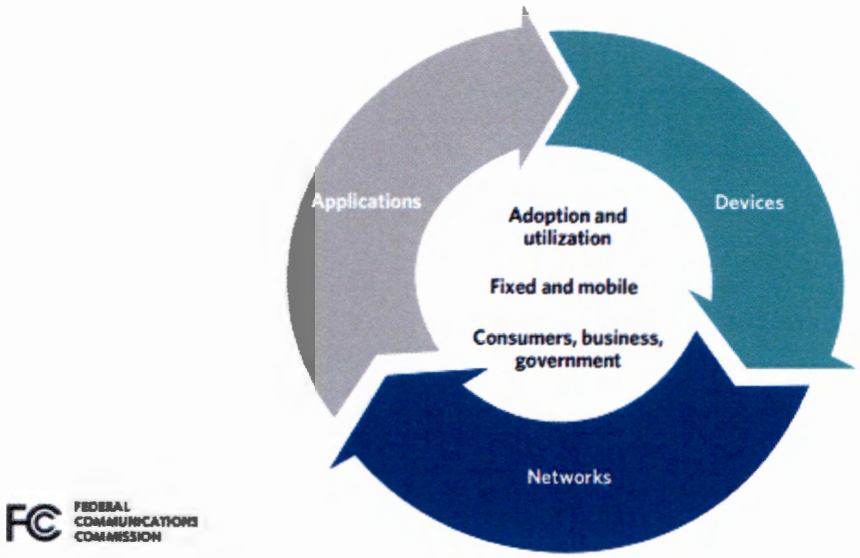
E-Services and Applications: Regional and national development of e-services and applications including e-post. Development of an ICT observatory.

Infrastructure: SADC integrated regional and national broadband infrastructure (Internet Exchange Points, shared satellites networks, Schools, hospitals, meteorology stations, wildlife conservatory centres, etc.)

Policy and Regulatory Framework: The legal aspect of all the above mentioned components of the broadband framework.

The above broadband framework for SADC is quite comprehensive and adheres quite closely to most broadband frameworks elsewhere. The two main sides of most broadband frameworks were addressed. These are the demand side and the supply side. Infrastructure, services and content define the supply side of the broadband while education and awareness pertains to the demand side of the broadband.

The policy and regulatory framework provides the environment in which all players and stake holders operate without short-changing one another. According to Shin & Jung (2012), the SADC framework fits within the conventional economic framework due to its approach and areas it addresses. Before pointing out some weaknesses and areas that need improvement in this framework, the USA Broadband Plan/Framework, Fig 1.5 is given in its skeleton form and discussed below:



America National Development Plan

Fig 1.5: Forces driving the Broadband Ecosystem (FCC 2012)

A glance at the above framework brings to light the fact that Networks and Applications are from the supply side whereas devices are of demand side according to TMG (2012) as shown in Table 1.1.1 and 1.1.2. These devices utilise applications via a network. So the networks are used by both, customers, businesses and government. The government at the same time plays the role of the regulator or the environment. Customers on the demand side adopt and utilise applications by their devices which can either be mobile or fixed.

The SADC framework compares very well with the above in that it divides its areas of attention into aspects that address the demand side of broadband and those that address the supply side of broadband in the economic sense. Both of the above frameworks do not address the social aspects of broadband.

The reason why most broadband frames are similar is the fact that they follow recommendations given by the World Bank Group. Below are two frameworks by the Telecommunications Management Group (TMG) which are recommended by the World Bank Group that should be followed in developing broadband frameworks. The first has goals that promote the growth of demand and the second, the supply of broadband. However, all the goals given by TMG are

economic goals and governments have endeavoured to implement them, either because they blindly approve of them or because it is a condition imposed on them in order to obtain funding from the World Bank.

Table 1.1: Policies that Promote Demand for Broadband (Telecommunications Management Group 2012)

Goal	Policy
Promote competition and investment	Incentivize private investors that invest in broadband. Promote rules that are neutral and that give flexibility to service providers. Promote service based gateways with equal access to all thereby encouraging competition on international gateways. Encourage competition between platforms.
Encourage government coordination	Adhere to common and internationally agreed standards and connectivity national backbones by all networks. Inculcate planning of broadband in the land and town plans.
Allocate and assign spectrum	Neutrality in the allocation of spectrum to service providers both to old and new companies. Promote the trading of spectrum by operators.
Promote effective competition and encourage investment	Encourage multiple providers to share physical networks (wireline and wireless)
Designate special area for infrastructure development (public rights of way)	Provide access to the designated areas to ease the construction of infrastructure Develop policies that promote and give private operators access to public infrastructure funded by government

Table 1.2: Policies that Promote Demand for Broadband (Telecommunications Management Group 2012)

Focus	Policy
Infrastructure	• Connect schools to broadband networks • Make government an anchor tenant • Expand access to underserved communities with universal service fund support • Construct community access centres
Services, applications, and content	•Implement demand aggregation as led by government • Provide e-government applications • Promote creation of digital content • Implement reasonable intellectual property protections • Ensure non-discriminatory access
Users	• Provide low-cost user devices for all government institutions • Conduct ICT training courses for citizens • Address content and security concerns • Facilitate affordability of broadband devices • Monitor service quality • Support secure e-transactions • Provide training to small and medium enterprises

The weaknesses of both the above frameworks are the following:

They reduce the problem of broadband growth and penetration to be attributable to common factors which are GDP, Education and awareness of the consumers of broadband, incentives to stimulate broadband and content development by suppliers, regulation and competition among suppliers to reduce prices. Looking at these factors alone and uniformly as areas of concern for every broadband framework has failed to yield desirable results especially in the third world because the uniqueness of a society has a strong bearing on their behavioural intention to grow

and adopt broadband. So a people's social aspects such as culture, history, language proficiency, and politics have a strong influence on broadband growth and penetration (Distaso 2006).

The approach of the above and many other frameworks on broadband growth and penetration do not reveal the interplay/relationships between social, technological and legal factors without which it's difficult to develop appropriate frameworks (Dutta & Rog 2005).

More so, not all factors have the same influence on broadband growth and adoption therefore a framework on broadband needs to show some ranking on factors as a way to help decision making and allocation of resources, that's according to Trkman, Blasic & Turk (2008). The above frameworks do not include that important aspect.

This research intends to address the above mentioned shortcomings identified in the current conventional economic model frameworks. Results of studies conducted in the recent past on broadband growth and penetration show the prevailing influence of GDP and economic development on the adoption of broadband. Studies of other possibly influencing variables have been inconclusive (Trkman et al. 2008). It is in these inconclusive studies that this research has its inspiration. The other influencing variables of broadband are social in nature and require a socio-technical investigation to unearth their impact on broadband.

As opposed to the conventional economic model, the use of the socio-technical approach gives assurance that projects that are technological in nature give outcomes that take into account the intricate interaction between technology and the social aspects. "It is widely acknowledged that ICTs and the social and contextual settings in which they are embedded are in a relationship of reciprocal shaping" (Borgman 2000). Given this assertion, this research intends to investigate the relationship between Technology, Society and Environment within the context of SADC. Some researchers have spoken of broadband influencing or changing the culture of societies as Borgman (2002) says. This research argues that the shaping is reciprocal therefore society should speak to broadband as much as broadband speaks to society.

1.2: Problem Statement

In order to enhance broadband growth and penetration in societies of different backgrounds, cultures and levels of development, an adaptive broadband framework that takes into consideration the uniqueness of the people among which it is to be implement is necessary. Such a broadband framework needs to consider broadband as a socio-technical system in which technology, society and their environment co-exist as an ecosystem where their relationships are complex, negotiated and multivalent. Furthermore, the framework should rank and interrelate latent factors that influence broadband growth and penetration as a way to help decision makers allocate resources for the development of broadband.

However the current broadband model being used by the World Bank and in many parts of the world is a conventional economic model in which broadband is seen as a business tool. In this model, it is presumed that human relationships can easily be changed to align with broadband conveniences and maximize on its business value, expert knowledge is easily made available, IT infrastructure is always supportive of the business goal and that the effects of technology are directly evidenced and quickly noticeable (Shin 2012).

Put differently, the prevailing broadband frameworks, not only in SADC but globally lack the inclusion of societal uniqueness (culture, demographics, politics etc) and how it relates to technology and its environment as an important part of the framework.

If the conventional economic framework model continues to be used uniformly in its current state among societies, we will not see much if any improvement in broadband growth and penetration especially among developing economies. As a result the digital divide and economic dichotomy between the first and the third world will persist.

Using the socio-technical systems approach, the following are the aims and objectives of this research:

1.3 Aim and objectives

The aim is this research is to propose an evolutionary and adaptive broadband growth and penetration framework for SADC.

The objectives are to:

- Determine the underlying latent factors influencing broadband growth and penetration in SADC.
- Categorise the factors of broadband growth and penetration into the determinants Socio-technical systems theory.
- Test the factors using data and Confirmatory Factor Analysis (CFA).
- Determine the categories of interventions required to satisfy the factors identified.
- Determine the ratio of economic policies to social policies needed per latent factor.
- Rank factors influencing BGP in SADC
- Identify attributes and social repercussions that are caused by socio-technical environment.
- Identify policies that address attributes and repercussions of a socio-technical environment

1.4: Research Questions

The primary research question is:

How can Broadband Growth and Penetration (BGP) in the SADC region be increased?

The secondary research questions are:

1. What latent factors are influencing broadband growth and penetration in SADC?
2. How do BGP factors correspond to each sub systems of the Socio Technical Theory (STT)?

3. How do the factors identified conform to gathered data?
4. What interventions are needed to increase BGP in SADC?
5. How do policies per given factor relate?
6. What are the most influencing factors of BGP in SADC?
7. What attributes and social repercussions inherent to and are caused by broadband growth and penetration?
8. What policies are needed to address the attributes and social repercussions of a Socio-Technical environment

Fig 1.6 below is the shows the mapping of aims to objectives illustrating which questions answer which objectives.

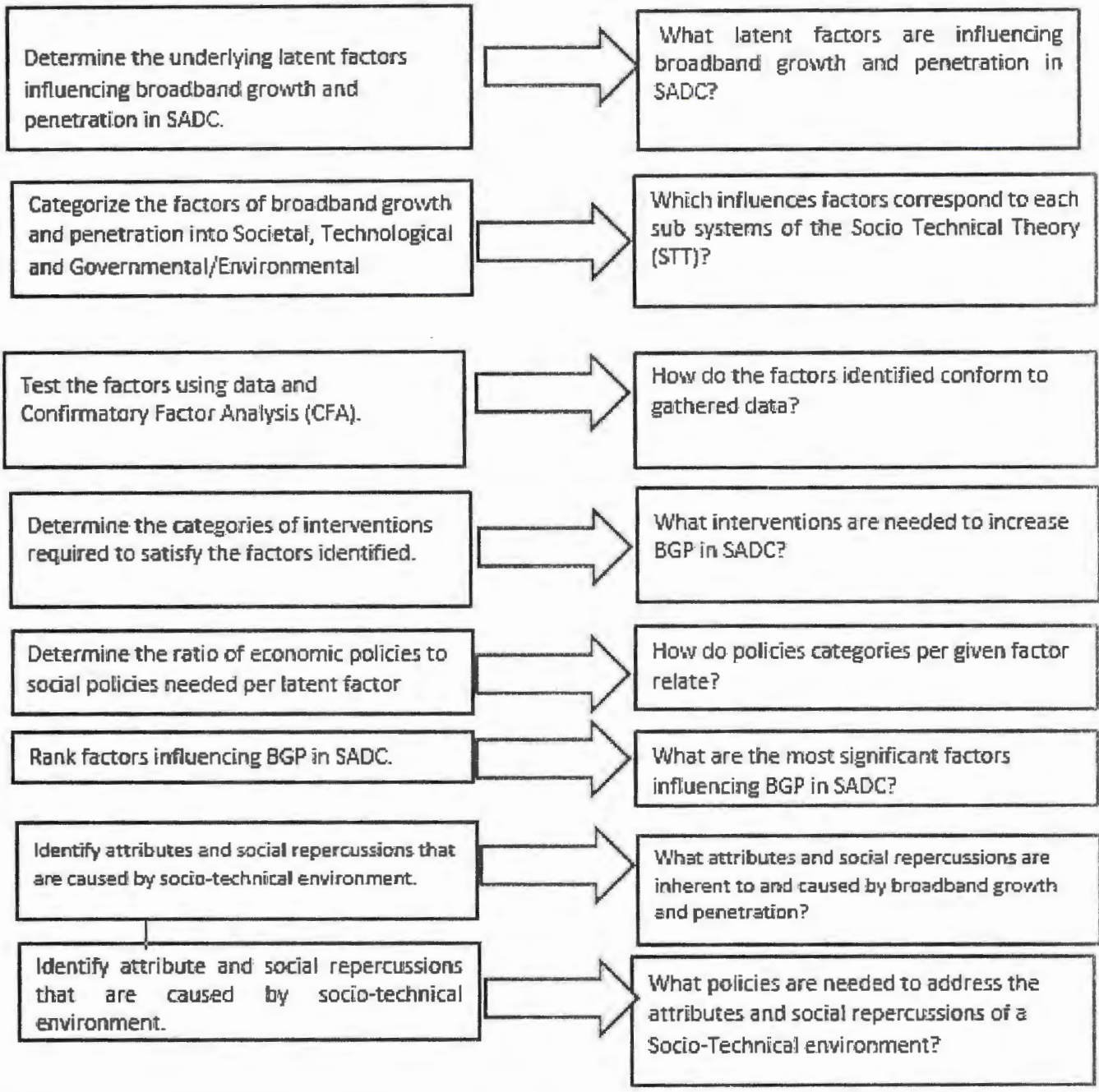


Fig 1.6: Mapping Objectives to Research Questions

1.5: The proposed conceptual framework

The proposed framework below is in three parts; Fig 1.7, Table 1.3 and Table 1.4.

Fig 1.7 that follows is an abstraction of the factors that influence broadband growth and penetration as categorized by the socio-technical systems theory that was used as a lens for this research. Each subsystem of STST has factors that can be categorized under it. These factors were obtained from literature by the research and tested using survey data.

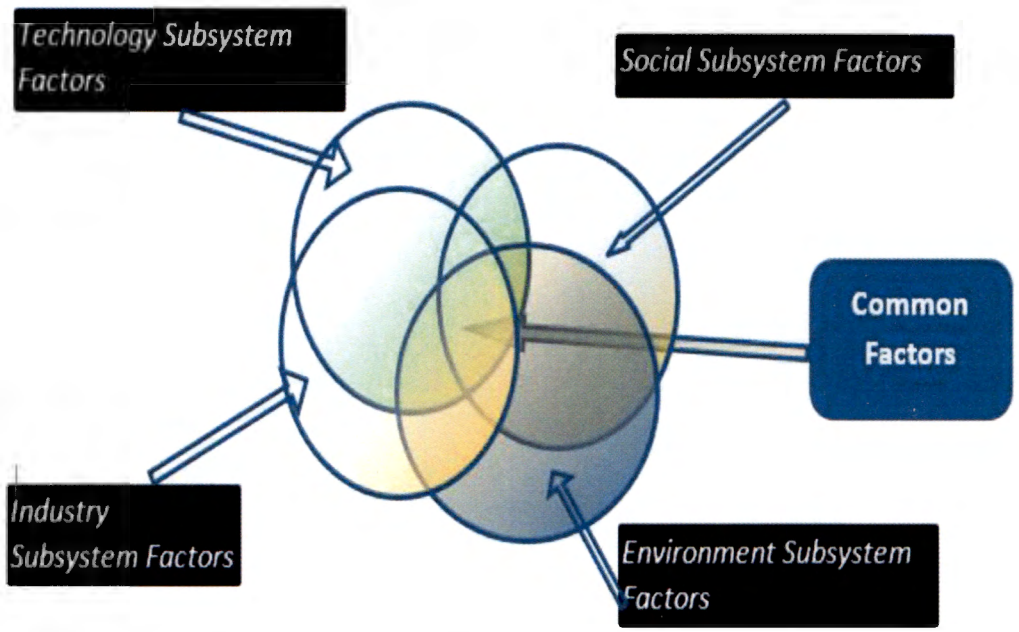


Fig 1.7: Proposed Broadband Framework
(Researcher's own)

Intersection area represents common factors for broadband development of all the four subsystems. The epistemological analysis of these determinants referred here to as subsystems should establish the underlying, hidden layer of reality that informs the relationships among these. This approach is purely the Socio-Technical theory approach.

Part of the proposed framework in Table 1.3 is an elaboration of the abstract Fig 1.7.1. It is four dimensional and relates broadband influencing factors, type of intervention to be taken and the ratio of the one intervention category to another. It also ranks these factors according to their order importance in influencing BGP in the region. All these aspects of Table 4.3 were obtainable from survey data.

Table 1.3: Decision-Making broadband Framework (Adapted from Telecommunications Policy 2008)

Interventions / Factors	Economic Policy	Social Policy	Weights or Rankings	Ratio of Economic to Social Policy per Factor
Society Subsystem Factors				
Environment Subsystem Factors				
Technology Subsystem Factors				
Industry Subsystem Factors				

Table 1.4 below is part of the proposed framework and it identifies possible attributes and social repercussions prevalent in a socio-technical environment (Shin &Jung 2012). The purpose of the table is to relate the attributes to pre-emptive policies that should address each of them. These attributes, repercussions and policy interventions were all obtained from participates of experts who took part in interviews that were conducted by the researcher in five SADC nations

Table 1.4: Socio-Technical Environment Attributes Framework (Researcher's own)

Attributes	Policy Intervention	Repercussion	Policy Intervention

1.5: Research outcomes

This research gives an adaptive broadband growth and penetration framework which should serve

as a basis for further research by other academics. It further provides awareness to the SADC in general and governments in particular, of the evolving needs of an information society. The platform should be used to evaluate the current broadband framework and serve as a benchmark for future broadband polies.

1.6: Significance of the research

According to The World Bank Group (2012) the importance of such a study is to facilitate greater levels of ICT and broadband usage as enablers of business and consumer services, education and research, life and leisure. A successful implementation of the proposed framework will enhance development of SADC's information and communications infrastructure and capacities as a globally significant region, creating an environment for Next-Generation-Networks (NGN) to flourish in order to ensure that advances in information and communication technologies are introduced and made accessible to SADC and businesses, in response to local and global demand. On the other hand, the proposed framework will help authorities to identify the major causes of low broadband growth and penetration in their region, country or organisation, thereby helping them to apply appropriate measures in terms of policies to curb the problem. The resulting framework of this research is evolutionary in that it is applicable to different societies and at varying time scales because its application should always be preceded by consultation or data gathering in order to populate the framework first. Therefore, the major strength of the framework is its adaptability to any people and its inability to work without first consulting the people.

1.6.1: Competitiveness

In all or part, the growth of telecommunications infrastructure and its utilisation are a factor in the measurement of the competitiveness of a country. Observations can be made in several competitiveness indices that countries that rank high in terms of competitiveness have a high level of penetration in the telecommunications infrastructure, and how it diffuses and contributes to development in other sectors (Teppayayon 2012). We can evidence the use of telecommunications infrastructure in robotics in car assembly, surgical operations, aviation, transport and many other sectors of the economy. One great initiative which will boost SADC competitiveness is the BRICS submarine cable network.

1.6.2: The BRICS submarine cable initiative

An "independent Internet System" which the BRICS (Brazil, Russia, India, China, and South Africa) nations are constructing with South Africa as the gateway for other African States is one such motivation for a robust broadband uptake in SADC. This network circumvents passing through western nation for political reasons. The positive aspect of this is that the 34,000km BRICS cable system will offer 12.8Tbps capacity between the five developing economies. This project has been in the planning and feasibility stages since March 2011 (Mybroadband 2013).

The BRICS cable will link the BRICS economies through a cable system which stretches from Fortaleza in Brazil to Vladivostok in Russia on the Pacific coast.

Not only is this initiative aimed at curbing spying on other states by West countries but more importantly its meant to link business to business between member states. South Africa being the only African and SADC state within BRICS automatically becomes the hub for connecting all other African countries to the BRICS economy. This is a business opportunity for SADC, making the development of a sound telecommunications infrastructural development based on appropriate framework a must for SADC.

1.7: Research design

Research is not just about the knowledge to be gained through it but it is also concerned the contextual settings within which it is conducted (Flick 2009). Hence, research design is a plan for collecting and analysing data that will make it possible for the researcher to answer research questions (Ragin 1994). Each research design has its strength and weaknesses. There are generally five research designs dominantly used by researchers; case study, longitudinal study, comparative study, and retrospective study. Some studies combine different research designs due to nature of the research.

A **retrospective study** takes in consideration analysis of events or processes historically form a given point in time. It is normally applied to biological studies (Flick 2009). This is applicable to this study because in order to evaluate the current policy, one has to look at past government

policies and their histories. History of a people has been identified as one factor that affects broadband uptake and this research took into account the historic perspective of SADC.

As this is done, comparison of framework documents is inevitable, hence **comparative study**. Currents frameworks being for broadband growth and penetration were compared and new one was proposed. This makes this research a comparative study.
The aim of **case studies** is the precise description or reconstruction of a case (Ragin & Becker 1992). The word "case" in this research refers to SADC. Sub cases are constituted by individual SADC member states. SADC was investigated in its setting, context and time as the researcher travelled to different SADC member states.

1.7.1: Data gathering Strategies

The primary survey instrument for data collection used were questionnaires. The major advantage of questionnaires is that they can easily be distributed to a large number of target population and provide responses in a way that is standardized. Fowler (2002) asserts that people are familiar with questionnaires and can be easily received by them. People can answer them at their own time thereby reducing bias in the responsws. The questionnaire standardises the way questions are asked, and how they are presented (Holliday 2007). The questionnaires were supplemented by internet interviews.

1.7.2: Data analysis methods

The research used Content Analysis, Hermeneutics and Cross-Case Analysis as qualitative research methods. The statistics mathematical tools that were used in data analysis were Confirmatory Factor Analysis as indicated in the objectives.

Content analysis is a way of reducing textual data from large volumes of data to meaningful and refined data that only speaks to the research questions at hand (Flick 2009). In this research online qualitative responses of about 450 participants were analysed using a Text Analysis Tool from Survey Monkey as explained in section 4.7. Interviews responses were analysed using Atlas.ti and content was reduced into themes by it as explained in section 4.6.

Hermeneutics is the art of understanding and interpreting the *meaning* of a text or text-analogue (Myers 2008).

"Interpretation, in the sense relevant to hermeneutics, is an attempt to make clear, to make sense of an object of study. This object must, therefore, be a text, or a text-analogue, which in some way is confused, incomplete, cloudy, seemingly contradictory - in one way or another, unclear. The interpretation aims to bring to light an underlying coherence or sense" (Taylor 1976).

This research reduced content from various sources to what addresses the research questions only, thereby employing content analysis. Hermeneutics is relevant because the researcher intends to establish the existing coherences and relationships among the subsystems under study in order to determine elements of consideration in the proposed framework.

In statistics, **confirmatory factor analysis (CFA)** is a special way of analysing factors of a give construct and is mostly used in social sciences (Kline 2010). CFA is used to confirm whether measurement of a variable is consistent with prior knowledge of the researcher about that variable. The main aim of CFA is to find out if the gathered data confirms the already existing theoretical knowledge about the construct under investigation. This hypothesised construct is based on theory and/or previous analytic research (Preedy & Watson 2009). In this research, most of the factors of BGP under consideration come from literature review, therefore they had to be tested by data from the field using (CFA) before the researcher could accept them as part of the proposed framework.

This research used SPSS and Atlas.ti computer software to aid with the above mentioned data analysis.

1.7.3: Validity

Validity has to do with correctness of the inferences drawn from dataset. The different types of validity criteria include external validity, internal validity, external validity and ecological validity (Bryman & Bell 2007).

Internal validity is how closely does data from the field represent the reality it purports to represent. One method of achieving internal validity is to triangulate data from different sources

(Yin 1994). This research used triangulation, member checking and peer debriefing as strategies for internal validation. Most importantly this research used datasets from different countries and consolidated into one outcome thereby achieving data triangulation.

External validity is concerned about the generalizability of the results of a study. One major limitation of case study is its inability to generalize results due to its focus on specific events (Yin, 1994). In this research, the specific results of data gathered in SADC may not apply elsewhere given the uniqueness of SADC. However, the research outcome of this study, which is an adaptive framework can be applied universally.

Ecological validity concerns with the question of whether or not social scientific findings are applicable to people's everyday lives or natural social setting (Bryman & Bell, 2007). To accomplish this, cultural and ethical considerations were adhered to during the research. More importantly, the results of this research were referred back to the focus groups to give their input.

1.7.4: Reliability

Flick (2009) characterises the discussion about reliability in qualitative research in two ways. Firstly, the origins of the data needs to be explained in a way that makes it possible to differentiate between a statement of the subject, and beginning of the interpretation of the researcher. The second aspect relates to training of field workers in procedures that need to be followed in the field and during the interviews. This enhances compatibility of results. (Orada2012). This research used inter-coder agreement or cross-checking. Coding is the process organising or categorising data from the field and labelling these categories using "in vivo" terms (the actual language of the participant (Creswell 2009).

1.7.5: Ethical Considerations

The following ethical considerations were be observed in this research: 1.The objectives of the research were articulated clearly, verbally and in writing for the informant to understand them. 2 The participants were asked for permission to conduct interviews with them and appointments were made before the dates of interviews. 3. Full disclosure of all data collecting devices was made to the participants. 4. Transcribed data was made available to the participants. 5. Rights and

concerns of the participants were taken into consideration before, during and after the interviews.
6. All the informants remained anonymous.

1.8: Literature review

A literature review is a "critical analysis of a segment of a published body of knowledge through summary, classification, and comparison of prior research studies, reviews of literature, and theoretical articles" (University of Wisconsin Writing Centre).

1.8.1: Socio-Technical Theory (STT)

According to Sawyer, Allen, and Lee (2003) an STT perspective is a robust way of analysing sensitive relationships that are both technical and social in nature, given that such framework of analysis should include technological and social details of large-scale ICT projects. From this perspective, Borgman (2000) conceptualised broadband as a socio-technical system. Sawyer et al. (2003) investigated broadband and mobile infrastructures from a socio-technical perspective. This approach to broadband is consistent with the concept of a broadband ecosystem introduced by Kelly and Raja (2010), in which broadband is a socially constructed artefact that is part of a cultural ecosystem. In a broadband context, STT addresses the social aspects of people and society, as well as the technical aspects of systems and technology. As a theoretical lens for broadband, "STT enables the investigation of the technical subsystem (comprised of infrastructure, equipment, applications and service), the social subsystem (market, customers and industry), and the environment (regulation, policy and society) that are all critical components of a developing broadband society" (Kelly & Raja 2010).

A socially rich view seems to better conceptualise the role of broadband in its current environment. The socio-technical model takes into consideration important factors such as the social and organisational context of the technologies and the people who use them (Shin & Jung 2012).

This research extensively used STT to examine the determinants for our broadband growth and in SADC and in proposing the resulting framework.

1.8.2: Delimitation and Limitations of this research

This research is delimited to SADC countries in data gathering although the resulting outcome is applicable anywhere.

The results of this research are space and time specific and may not hold elsewhere nor in the future even though the developed framework can be used anywhere and at any time.

1.8.3: The Novel Aspect of the Research

The proposed four dimensional framework is something new in its approach to the question of broadband growth and penetration as seen by its inclusive nature of the economic convectional model and the social aspect in the same broadband framework. The interaction between society, technology and policy has been studied and there is literature available, however, it is the development of a comprehensive framework and its differential application to problem domains that has not been done. Thus, this known information was integrated into knowledge applicable to solve the research question.

Mugeni, Wanyembi and Wafula (2012) did a research on "Evaluating factors Affecting Broadband Adoption in Kenya". Their research did not necessarily use the Socio-technical approach nor did it culminate in a usable framework as that was not its aim. However, some factors mentioned in their research have been also considered in this research.

Shin & Jung (2012) conducted research on "Socio-technical analysis of Korea's broadband convergence network: Big plans, big projects, big prospects?" these researchers conducted a socio-technical analysis of the Korean situation. This research borrowed many concepts from their research. However, theirs was only a socio-technical analysis of broadband convergence. The current study has an adaptive framework as its outcome.

Orada (2012), researched on comprehensive framework for future broadband policy in Europe Union, his thrust was on policy and followed the TMG policy model which does not consider social policies as discussed above. Therefore, Orada (2012)'s research comprises just one end of the present study; the Environment subsystem.

This research considers policy but not in isolation, it is one of the four subsystems under research and more importantly this research centres on the network between the said subsystems and their relationships as the cracks of the poor broadband growth and penetration in SADC. This is the unique contribution made by the current study.

1.9: Structure of the research

Chapter 1: Introduction

To introduce problem areas and motivations

Chapter 2: Literature Review

Review of existing literature on the subject under study to establish the gaps and motivation for this research.

Chapter 3: Research Methodology

Methodology used well explained and in the context of a philosophical approach.

Chapter 4: Research Results and Analysis

Analysis of research results

Chapter 5: Conclusions and Recommendations

Conclusions limitations and recommendations for future studies To conclude the findings of the thesis and provide framework implications and directions for future research.

CHAPTER 2: LITERATURE REVIEW

2.1: Introduction

The purpose of this chapter is to both appreciate and to critique recent studies conducted by other researchers on broadband with the objective of filling in the gaps left by these studies. Using previous studies as a foundation, this work intends to make a contribution to the already existing body of knowledge by articulating both the limitations of previous work and introducing a new approach to the question of broadband growth and penetration in general. This new approach is consummated in a proposed framework for broadband growth and penetration using a case study of SADC.

This review adopts a thematic approach where concepts are dealt with according to themes they belong to and where applicable a funnel format to concepts is used where concepts are explained from broad to specific.

The scope of this literature review includes studies conducted about broadband growth and penetration in different societies of the world. Value of broadband in various sectors of the economy and society is reviewed as a precursor and motivation for the need of enhanced broadband growth and penetration. Of this review, studies that have looked at broadband frameworks have been considered. However, studies that have utilised a socio-technical approach to broadband are reviewed separately as these lead directly to the research topic of this work; towards an adaptive socio-technical broadband growth and penetration framework.

Firstly, an ontological and epistemological analysis of broad is given in sections 2.3 and 2.4 respectively. A consolidation of the value of broadband and its complexities as a further justification for pursuing this research is then given in section 2.4.3. Prior to discussing the value of broadband and its complexities, section 2.4.2 discusses broadband as a public good. Section 2.4.4 discusses the concept of policy. Section 2.5 of this chapter discusses some broadband frameworks studies that have been conducted in the recent past. An in-depth analysis of these works is done in view to appreciate them and unveil any controversies and limitations in order to propose solutions in context of the topic under research.

A theoretical framework that has been employed to couch the question of broadband as enunciated in the previous chapter is covered from section 2.5.2. This is then dealt with in more detail in section 2.5.4 which culminates in a Socio-technical systems theory, the lens through which this research is conducted. In section 2.6 the proposed framework for broadband growth and penetration in SADC and relevant concepts as pertaining to the adopted approach by the researcher are discussed.

In conclusion, this chapter analyses the works on broadband that have been done in the recent past in view to critique it by pointing at the gaps in these works and then proposes solutions to fill in the identified gaps. In the next section, the topic under research is explained in detail followed by a synthesis of broadband as a public good and the value of it.

2.1.1: The research topic

The title of this research as given in chapter one is: Towards an Adaptive Socio-Technical Broadband Growth and Penetration (BGP) Framework: A case of SADC.

"Towards an adaptive…" speaks of a framework which can be adapted to suit any society by first carrying out a survey to determine the uniqueness of that society at that time as was done for SADC. The proposed framework is by no means absolute and definitive but can always be improved by further research there "Towards".

"Socio-Technical" refers to the standard theory used to conduct this research which at the same time constitutes the central argument of this research as shall be explained in section.

Broadband Growth and Penetration – "broadband as the provision of telecommunications infrastructure that enables information traffic in a continuous and uninterrupted manner, with sufficient capacity to provide access to data, voice and video applications that are common or socially relevant to users as determined by the" SADC "from time to time" (World Bank 2012). Broadband growth is extent to which broadband infrastructure has reached, geographically and broadband penetration is the amount of the internet access market that broadband internet has captured.

"Framework" comprises overarching principles, procedures and guidelines used for promoting broadband growth and penetration (University College Dublin 2014).

"A Case of SADC" this refers to the fact that data collection was done in SADC countries and results from each country compared to establish a general trend among all countries.

In the interest of a sound application of this approach, it necessary to first analyse the broadband reality space ontologically, epistemologically and humanly.

2.3: Ontological analysis

In this context, ontology refers to what can be known about reality or the world (Mavetera 2010). There are many entities that are dealt with and can be enumerated in this research but in trying to understand what makes up the reality space for this research, the researcher only focuses on what he considers essential constructs in understanding the depth and scope of the research. These important concept as explained in detail in section 3.2 are broadband, policy, Conventional Economic Approach, society, technology, environment, framework, systems theory, and socio-technical systems theory.

Enumerating the entities in the reality space under research alone cannot suffice without understanding the relative meanings of these entities and how they relate to each other. Hence the following sections deals with the epistemology of the mentioned entities.

2.4: Epistemological analysis

According to Conford and Smithson (1996) as referenced by Mavetera (2010), epistemology is regarded as valid knowledge that is obtainable regarding a phenomenon under study. It also refers to the relationships between the entities in a reality space. This addresses concepts as they are understood at that time. This section explains the concepts and relationships of the entities identified in section 2.3. It is essential to note that even though the epistemological elements of this research seem to end with section 2.4, it is by far not the case. Epistemology runs through to end of this chapter, even to the end of the whole thesis. This is so because valid knowledge of the all concepts discussed in this work and their relationships pertain to the domain of epistemology.

2.4.1: Broadband

Scott Peck (2006) argued in the work *The Road Less Travelled*, Arrow Books. P. 33:

"...we are not born with maps; we have to make them, and the making requires effort. The more effort we make to appreciate and perceive reality, the larger and more accurate our maps will be. (...) the biggest problem of map-making is not that we have to start from scratch, but that if our maps are to be accurate we have to continually revise them. The world is constantly changing. (...) the vantage point from which we view the world is (also) constantly and quite rapidly changing. (...) We are daily bombarded with new information as to the nature of reality. If we are to incorporate this information, we must continually revise our maps, and sometimes when enough new information has accumulated, we must make major revisions [to our map]. The process of making revisions, particularly major revisions, is painful..."

The above passage points directly to philosophy as our perception of reality, which perception is in constant change. Humans are hereby regarded as active agents of this change, making the process a continuous and unending one. It is however interesting to note that Peck's assertion has far reaching implications that affect our understanding of socially constructed artefacts such as broadband. The meaning of broadband has evolved with time to such an extent that its definition today is relative to the nation in question. Each country has its own definition of broadband and this definition keeps changing.

Definitions based on data transfer speed do not consider the fast pace at which technology is evolving. Is a bandwidth of 256 kbit/s a broadband connection? Should the lower limit be set to 1 Mbit/s? There is no one answer because the bandwidth required support application, especially online applications keeps improving rapidly due to growing demand. Definition based on particular speeds can be true at particular points in time (EU 2008). The term "broadband" refers to various aspects of networking infrastructure and service and these include the following: "1) Infrastructure used 2) Speed of access to the Internet; and 3) Services and applications provided, such as Internet protocol television (IPTV) and voice services that may be bundled as a 'triple play' package (one in which video, voice and data are provided for in a single access subscription) with broadband Internet access"(World Bank 2012). Furthermore, every country has its own definition of broadband based of speed of traffic or based on the application or services that are executed over the network. Owing to the uniqueness of each country which speaks to the needs and history, including economic, geographic and regulatory factors, definitions of broadband vary widely (World Bank 2012).

In SADC "broadband is defined as an always available, multimedia capable interactive network connection with characteristics, as determined by Ministerial Policy and published in Regulations by the Authority from time to time" (National Broadband Policy 2013).

This research uses as a working definition of broadband as "the provision of telecommunications infrastructure that enables information traffic in a continuous and uninterrupted manner, with sufficient capacity to provide access to data, voice and video applications that are common or socially relevant to users as determined by the" SADC "from time to time" (World Bank 2012).

The following sections looks at attributes of broadband in terms of its value, complexities and some of its areas of applications.

2.4.2: Broadband as a public good

In some developed and developing nations, broadband is run by the government or state controlled agencies until late 20th century (Picot & Wernick (2007). In congruent with these two, the move to have telecommunication controlled by the state was necessitated among other things by the need to protect those aspects of telecommunications that are of public interest. Today, even though many telecommunications markets have been privatized and liberalized, government regulatory agencies are still responsible for ensuring that public good issues are provided for. These issues are security, prevention of interference while transmitting and client safety. Tho things distinguish public goods from all others and these things are: Non-excludability, that means any member consuming a public good cannot be denied it by another member enjoying the same public good (Olson Jr 1965). The second characteristic is that a public good is non-rivalry in consumption (Musgrave 1969). This means therefore that public goods should be provided for by the government to guarantee non-rivalry in the market. In some developed countries broadband forms part of Universal Service Obligation (USO), meaning that it is the citizens' right to have access to it and governments should provide for it. In most countries however telecommunications is just a universal service and not necessarily an obligation on the part of government. It is in the potential benefits of broadband and a common thrust to bridge the digital divide which gives broadband its public good character.

It is this inherent quality of broadband that in part necessitates the need to establish a framework for its growth and penetration that gives better results than have been seen in the recent past,

specifically among developing economies. The other main motivation for adequate and robust broadband growth and penetration is the fact it has been proven that economic growth of any nation is directly proportional to broadband uptake of that nation. Therefore sectors of business and public life are directly affected by accessibility to broadband.

2.4.3: Value and complexities of broadband

According to South African National Broadband Policy (2013), broadband is a tool for the development of economies that are based on knowledge. Many studies corroborate that enhanced broadband penetration has desirable effects on the growth of any economy, improved access and delivery of social services apart from bridging the digital divide. All these impacts of broadband result in high quality way of living and economic index of countries. Firth and Mellor (2005), further assert that broadband is at the centre of organisations' improved efficiency, faster connectivity, and access to operation-specific applications which usher in new ways of doing business and give birth to new business models.

In considering the value of broadband, research has concentrated on benefits of it singly without taking into account the problems that inherently comes with these benefits. There are quite some complex issues that tend to hinder proper of the benefits of broadband. One such issue is the confusion that literature has had between benefits of broadband and its applications, attributes of broadband and the activities that these attributes enable. "Applications include video on demand, gaming, streamed video, and voice over the internet. Attributes include greater speed, always on and the capacity for LANs. The activities that these attributes enable include teleworking, e-gaming, e-gambling,
e-learning, e-health, e-commerce, and e-government" (Bauer, Gai, Kim, Muth & Wildman 2002). Publications of repute and which have contributed immensely to broadband research but which made this ontological error include ITU on their briefing paper on broadband promotion according to Reynolds and Sacks (2003).

The other one is that confusing benefits with activities gives the notion that it is gross outcome rather net that counts. In so much as broadband-enabled activities bring benefits, they also have negative outcomes which include increased worker isolation and less mentoring in the case of

teleworking, financial problems (e-gambling), and displacement of conventional social contacts in general (Katz & Rice 2007).

Another complexity is that of cost, if the cost of broadband excludes multiple voices in favour of a monopoly then there is need for constitutional and social considerations (Firth & Mellor 2005) From the above given arguments, it is clear that a high broadband penetration does not equally mean high broadband benefits. Furthermore according to Crandall and Jackson (2001), calculated revenues expected to be coming from broadband related enterprises do not reflect an adequate measure of benefits of broadband. Lastly, owing to poor planning and veiled understanding of broadband scenarios, the ways by which governments sometimes attempt to use to grow broadband may disrupt the economic and social dynamics (Bauer et al., 2002).

Notwithstanding the highlighted complexities associated with accurately identifying the benefits and hence the value of broadband, the following section explains the broadband benefits in five main areas:

2.4.3.1: Education

According to Bauer et al. (2002), where e-learning is asynchronous, meaning where there is no need for real time interaction between student and instructor, narrowband is sufficient. However when synchronous and collaborative learning in real time takes place, broadband is needed. Where multiple students access the web simultaneously, even for asynchronous e-learning, broadband is needed. Broadband therefore has the ability to provide educational platform which transcends geographical and financial challenges (South African Broadband Policy 2013).

2.4.3.2: Health

Broadband applications that are health specific and services are significantly improving health and medical outcomes around the world, particularly for patients in remote areas and those with limited mobility, through e-health and m-health initiatives (WHO 2005). In view of the fact that in 2012 there were "fewer than 27 million doctors and nurses for the more than 6 billion people in the world and only 1.2 million doctors and nurses in the lowest-income countries", using mobile

technologies is a valuable tool for enabling health care practitioners to reach patients The World Bank (2012). In spite of the fact that voice and data connections can be useful in improving medical care, broadband connectivity is necessary if full potential of e-health services that include telemedicine, which enables real-time audio and video communications between patients and doctors as well as between health care providers, broadband connection is required. Online medical procedures need high processing power, huge storage capacity, much bandwidth and protection of personal data of patients. (ITU 2008, 11).

2.4.3.3: E-Governance

E-government refers to a wide range of applications that transform government processes and the ways in which governments connect and interact with businesses and citizens. This facilitates citizens participation in national issues and society, improves accountability, effectiveness and efficiency in governments' day today business. Broadband is an essential component of e-government, since it provides the foundation for public administration networks that allow smooth flow of processes. E-government can in return be a catalyst for increased demand for broadband as basic services are made available online, consultations with citizens on issues of policy and online multimedia as two way exchange technology. Tax returns, debate forums, applications and registrations are all made easily available by e-government as enabled by broadband. Republic of Korea, the United States, and Canada are in the top three places with regard to the number of online government services available. However, countries have made significant progress over the last two years, including Bahrain, Chile, Colombia, and Singapore. In addition, the use of mobile phones for e-government services, such as alert messages, applications, and fee payments, is almost as popular in developing countries as it is in developed countries (UNPAN 2010).

2.4.3.4: Broadband and Gross Domestic Product

A study by the World Bank cited by many researchers found out that for low to middle income countries "about a 1.38 percentage point increase in GDP for each 10 percent increase in broadband penetration" between the years 2000 and 2006 (Qiang & Rossotto 2009, Kim, Kelly, & Raja 2010). The same study further revealed that broadband impact was more in developing economies than in developed countries which "enjoyed a 1.21 percentage point increase in per capita GDP growth"

for each 10 percent increase in broadband penetration. This study also evidenced that broadband has a potentially larger growth effect than other ICTs, including wireline telephony, mobile telephony, and the Internet. There are other studies that confirm the findings of the World Bank such as Management consulting firm McKinsey and Company which estimated that "a 10 percent increase in broadband household penetration delivers a boost to a country's GDP that ranges from 0.1 percent to 1.4 percent" (Buttkereit et al. 2009). It therefore, follows that broadband can increase the economy of a country by e-commerce, creating new jobs, developing and attracting new industries and by providing access to local, regional and global markets.

2.4.3.5: Broadband and cloud computing

Cloud computing generally allows storage, processing and instant access to applications and data remotely via broadband connectivity (World Bank 2012). This translates into reduced costs of IT infrastructure including hardware, software and technical support. The point to note here is that the benefits of cloud computing are directly the benefits of broadband because without broadband cloud computing as we know it today would not be possible.

According to Zhang, Cheng, and Boutaba (2010), cloud computing has the following other potential benefits: "• Reduced need for up-front investment, since cloud computing is typically based on a pay-as-you-go pricing model • Lower operating costs, since the service provider does not need the provision capacities according to the peak load • Easy access through a variety of broadband-enabled devices • Lower business risks and maintenance expenses, since business risks (such as hardware failures) and maintenance costs are shifted to infrastructure providers, which often have better expertise and are better equipped to manage these risks".

There are many other benefits of broadband such as leisure, entertainment, social relations, gaming, green computing, aviation and much more. Governments across the globe have set out ambitious targets for broadband growth and penetration due to the unquestionable value of broadband as discussed above. Policies are the only tools that governments use to ensure their plans are implemented accurately and consistently. The following sections discusses the concept of policy.

2.4.4: Policy

According to the University of Sydney (2012), a policy can be regarded as a system of principles that are used to direct and guide decisions which when implemented give rational results or outcomes. It is a pronouncement of purpose which is executed as a protocol. Policies are usually adopted by strategic level management of organizations or government departments. Policies assist in both subjective and objective decision making. Policies that assist in subjective decision making help senior management come up with decisions that must consider the relative merits of a number of factors before making a decision. Such policies are difficult to test in an objective way. An example of such a policy is a work-life balance policy. In contrast policies that assist in objective decision making are usually operational in nature and can be objectively tested e.g. password policy

It is difficult to come up with a universally agreed definition of policy as the use of the term can be different from organization to organization and sometimes it is used differently within the same organization. However, even though it is difficult to coin a universal definition of policy, there are some common aspects of it found in most policies and according to University of Sydney (2012); these are: "it states matters of principle, it is focused on action, stating what is to be done and by whom and it is an authoritative statement, made by a person or body with power to do so."

More importantly, a good policy is meant to be a tool which makes administration easier, and allows organisations to do their core business more efficiently and effectively. As indicated above, the policies in question here are policies that have to do with broadband as a social construction and as a public good.

2.5: Humanistic analysis

The relationships of human beings also regarded as actors with their environment constitutes the humanistic assumptions (Mavetera 2010). In the context of broadband the environment that interacts with human being is both technology and government which is responsible for regulating the space of interaction. In line with the theory that this research is using, the humanistic aspect is

comprised of the society as a whole. Government, industry and the market also have a human element but that element is not separated from society.

As explained in detail in chapter 1 in problem definition that the main reason for low broadband growth and penetration can be traced back to the models that are being used to harness broadband. The section that follows analyses recent studies that have used conventional economic approach to broadband growth and penetration as well as those studies that have used the socio technical approach.

2.6: Approaches to Broadband Growth and Penetration

The current prevailing approach to broadband growth and penetration is largely economic in nature. Although a socio-technical approach is beginning to be used to analyse broadband related issues, not much progress has been registered in this approach.

2.6.1: Conventional Economic Approach to Broadband Growth and Penetration

Considering section 2.4, it follows that the importance of broadband to a functional and smart information society is huge. Consequently, governments across the world have prioritized broadband growth and penetration (Papacharissi & Zaks, 2006). In view of this eminent need to harness the benefits of broadband, Flamm and Chaudhuri (2007) submit that researchers have been having a difficulty understanding the impact of Internet technology and were hampered by both the newness of the field, the absence of data, and the lack of firm and universally agreed upon theoretical structures. Evidently implementation of new technologies either by governments or private enterprises should be informed by research. It therefore follows that when research lacks robustness, so do the implementations that draw from it.

Since the advent of broadband and for the past decade, investment in broadband has been viewed as an outlay of equipment to improve technical capabilities (Joo 2005). Hence, broadband development has in most cases been seen and evaluated against the metrics of economic efficiency and physical growth without taking into account the social aspects which are important and fundamental to the question of broadband (Shin & Jung 2012). This suggests that broadband

should not be understood only in the context of enabling business but inclusively with its social implications.

Flamm and Chaudhuri (2007) in their 'An Analysis of the Determinants of Broadband Access', set out to investigate the most determining factors of broadband penetration. The results of their research gave evidence that indeed price of broadband services is statistically a significant driver of broadband demand. This was mostly in contrast with the general consensus as highlighted by the National Telecommunications and Information Administration (NTIA). It suggests that there is a strong correlation between race, age, and levels of income, education, and broadband access decision. This has been supported by GAO (2001), UCLA (2000) and Leigh and Atkinson (2001). One further conclusion which the two arrived at and importantly so is that cost is the obvious limiting factor of broadband demand and both unsubstantiated and sparse: 'because high prices for broadband co-exist with low penetration rates does not necessarily imply that the latter is primarily caused by the former', they argue. What is interesting in this work is that after controlling the price, the duo found out that non-price factors exist and affect broadband growth somewhat differently.

It is apparent, that even though their work concluded with results that hold true, it was conducted under the bias of conventional economic perspective, hence it could not articulate the non-price factors nor their impact.

Another study that is of significance was done by the World Bank (2012), in their book. "Broadband Strategies Handbook". It is important to note that many researchers on the subject of broadband have used the World Bank model as a reference point. As regards broadband development framework or plan, the World Bank (2012) has highlighted the following pertinent issues:

Governments need to conceptualize broadband as an ecosystem of supply and demand. These two aspects of broadband are interdependent and mutually reinforcing each other. According to Kim, Kelly and Raja (2010) the elements of supply in the broadband ecosystem comprises four levels: international connectivity, domestic backbones, metropolitan connectivity, and local connectivity. The demand side of the ecosystem include components such as services, applications and content.

Notably the supply side is the first determinant of demand as it pulls it and the demand in turn pushes the supply World Bank (2012).

A further submission by the World Bank concerns the absorptive capacity of broadband. This is defined as the ability of an organisation to identify the value of new external information, assimilate it, and then to apply it to the organisation's benefit. 'This ability is critical to an organisation's innovative capabilities, as new technologies are assimilated by organisations to create, improve, and transform business processes, products, and services' (Cohen & Levinthal 1990).

According to Duchek (2013), a country's absorptive capacity is determined by the following: the "capacity of businesses to create broadband-enabled services and" applications and to use these applications and services to make their business processes more productive and efficient, the capacity of citizens to "create and use broadband-enabled services and applications to improve their welfare, the capacity of government and other institutions" such as hospitals and schools "to introduce and accommodate broadband-enabled" services to deliver public services more efficiently and transparently to the public. This position is congruent with many other researchers including the World Bank.

The World Bank (2012) further asserts that governments have to play two roles in promoting supply; "by making markets more competitive, efficient, accountable and transparent and by ensuring equitable access for all" service providers. The "role of government should be to facilitate, and complement market development" instead of substituting government decisions with market forces and public sector investment with private investment.

According to Pew Internet and American Life Project (2010); EUROSTAT (2009) on inhibitors of broadband adoption by user, the four categories barriers identified are: 1) broadband is not relevant; (2) equipment or service is too expensive; (3) individuals lack training in or are not comfortable using broadband Internet services; and (4) broadband is not available. The role of governments with regards demand of broadband is to address the above for groups of inhibitors. This research results have the backing of the World Bank as its basis for supply side policy recommendations.

Lastly in what is considered from the World Bank (2012) in this research, intervention by governments in form of policy necessary to address challenges of broadband development. According to them, the following policy areas are necessary for broadband growth and penetration: policies that improve access to shared public infrastructures (passive infrastructure) such as conduit, poles, and ducts and to organize civil works as a means to encourage investment, policies that ensure access to rights-of-way or access to national network grid in a fair and non-discriminatory manner, policies that encourage and promote the installation of open access to passive infrastructure when public works are undertaken and policies that allow municipalities to enter telecommunications markets where market distortion is prevalent. The World Bank suggests also policies that limit municipal participation to basic investments under open access rules to service providers, policies that provide greater and easier access to spectrum and its efficient use.

This research acknowledges the great contribution of the World Bank research specifically on the supply side of broadband. It is worth noting that some policy suggestion for the supply side can inherently also solve some problems of the demand side, for example open markets encourage competition and as a result tend to lower the prices. Policies on quality assurance and accountability of service provider in turn create favourable condition for demand of broadband.

However, in developing economies market forces that are supposed to lower prices in open markets are defeated by monopoly of production and ownership of means of production. As such, prices don't tend to decrease in a monopoly since there aren't meaningful market forces. The only way prices can easily be made affordable in a monopolized economy is when government impose tariff controls. This as well can scare investors and it becomes a self-defeating pursuit.

Hernandez, Leza, and Ballot-Lena (2010) argue that broadband barriers in one country do not necessarily have to be the same as in another country and this is due to different socioeconomic conditions, histories and cultural conditions. On this basis, some of the policy recommendations given by the World Bank can not apply to other people groups. What may be a factor in one country may not be a factor in another country.

Through the concept of absorptive capacity as explain above, researchers have concluded that organisations need to identify new and external knowledge, assimilate it and use to their advantage. Further to that, the notion is that when technology is new then users need to be trained in order to

be able to use it. Such a bias leaves society as a passive entity which should conform to the dictates of new technology. Analogically, researchers have concluded that such approach should be used for broadband. This precisely means that broadband has the ability to change societal settings and values. However, Borgman (2000) states that ICT and the social context in which they find themselves are in a relationship of reciprocal shaping. This means society has to speak to broadband the same way as broadband speaks to society, maybe not by the same amount. This is why this research is proposing a new approach to the question of broadband growth and penetration. The conventional economic framework of broadband is critiqued, precisely because of the above mentioned shortcomings.

In his work entitled "Lessons from broadband development in Canada, Japan, Korea and the United States", Frieden (2005) arrived at the following important conclusions considering Canada, Japan and Korea only, Firstly, that broadband thrives when it becomes a national priority. This is a valid observation as it's supported by many other researchers. Secondly Frieden (2005) concluded that economic policies do not completely explain why some nations thrive in broadband growth or why they offer faster, cheaper and more convenient broadband than others. This conclusion points to the fact that apart from economic policies, social policies need to receive as much attention from governments. It is essential to note that the importance of Frieden (2005) work lies in the fact the four countries in question were not performing badly in terms of broadband growth. According to ITU (2005) ranking Korea was on the first position, Canada and USA on the 6th position. Even though Japan was not in the top 6 but it could have been used as a control. According to his work, the United States government used two funding models to promote broadband with a goal of withdrawing once the critical mass of resources were in the hands of private enterprises. These modes are: A top-down approach, where government builds infrastructure and provides incentives for investment in broadband services and a bottom-up ''community aggregator model'' where government underwrote and funded pilot programs.

There are common recognisable trends among these four nations which could have assisted them to achieve broadband growth. These include regulatory parity that promoted facilities based competition and market entry by operators who might need to access some facilities that were already established, direct underwriting, loans, favourable tax treatment, and other types of financial support for construction of high capacity backbone broadband networks, financial

support for research and development (R&D) and subsidies for buying of ITC equipment, promoting digital literacy and supporting electronic government, education, e-commerce healthcare and other types of ICT-mediated services. In conclusion the researcher underscores the need for a recurring subsidy and funding mechanism as opposed to ad hoc funding.

The above observations are quite pertinent, however these policy measures as mentioned above have not yielded the same results in different countries including these four countries. Besides, policies that might be universally agreed to be working in some countries do not necessarily have to work elsewhere and such policies do not exclude the possibility of other policies of equal importance or even better. This research argues that in so much as economic policies have achieved milestones in promoting broadband growth and penetration, they need to be complemented by social policies, policies that are focused on the human factor, that take into account the uniqueness of societies among which broadband is deployed.

According to ITU (2014), in their latest release of the "State of Broadband" by the end of last year 2014, 2.9 billion people were online, which was about 40% of the world population. At current growth rate, by 2017, half the world population would be online.

Notwithstanding the above statistics, the same report gives the distribution of internet user penetration at 32% for the developing countries, 40% average and 82% for the developed countries (ITU 2014). This shows that the developing world is almost 3 times less connected compared to the developed world. Clearly the histories of the developed and the developing communities are different, their cultures and social settings are different, their economies are vastly different and these differences have been, even before the advent of broadband. It therefore follows that the policies that have yielded good results in developed countries have not yield as good results among developing countries. Therefore the cause for the difference can only lay in the differences between these groups of countries as outlined above. Cardinally, these differences are socioeconomic in nature. This necessitates the development of social policies to complement the economic ones largely at play today.

With holes having been poked in the economic model as argued above, with other researchers even of economic models identifying non uniformity in societies necessitating differential application of economic policies and with even others spotting non price factors of broadband growth and

penetration, it becomes necessary to explore the social aspects of broadband. In view of this, the following section addresses the socio technical approach to broadband.

2.6.2: Socio-Technical Approach to Broadband Growth and Penetration

Congruent with Shin and Jung (2012) Social and cultural considerations are of paramount importance if any broadband system is to succeed. Joo, (2010), Preston, Cawley, & Metykova, (2007) concur with this assertion. In line with them, broadband should be used as a vehicle to bridging different cultures by addressing various social issues and problems, therefore a frame work for such action is important. This research uses a socio-technical approach to couch the question of broadband growth and penetration. The socio-technical approach is based on socio-technical systems theory.

The paucity of comprehensive generalisable scholarly material on socio-technical approach to broadband is notable. However, some researchers like Oni and Papazafeiropoulou (2008) in their work "A socio-technical approach to broadband diffusion by SMEs" discovered perception gaps among groups responsible for broadband diffusion and attributed those gaps to slow uptake of broadband among SMEs. The researcher reckons that perception is key to engaging in any activity. Therefore in essence the contribution of the research mentioned above would be to call for training and campaign. This complements the economic approach's call for training at workplaces.

Shin (2009) in his work "A socio-technical framework for cyber-infrastructure design Implication for Korean cyber-infrastructure vision" did a tremendous work in applying a socio-technical approach in analysing how cyber infrastructure (CI) will evolve and stabilize in the cyber space in Korea. His work also investigated the complex relationships that exist between social and technical aspects of CI owing to the evolving nature, diversity and interface which constitute expected of in the next generation networks. The works also describes the challenges associated with development and deployment of CI in Korea. Some notable conclusions from this work are that Korean people's involvement in information ecology depends largely on the motivation people have and their attitude towards CI. There a tendency in Korea of thinking that the impact of CI on culture and society are just side benefit of efforts targeted at benefiting scientist. CI planner have a top-down approach and do not involve all stake holders. There is need for strategic IT planners to in-cooperate social issues on technical aspects and have information campaign of overall

national strategy among other conclusions. Shin (2009)'s work brings a great contribution to the socio-technical approach and this research borrowed a lot from it.

Another equally masterpiece of research was done by Trkman et al. (2008) entitled "Factors of broadband development and the design of a strategic policy framework". Their research was aimed at determining factors that affect broadband development in EU countries using Exploratory Factor Analysis. The factors were identifies and strategic policy framework was developed. This research has enhanced that framework as part of its overall proposed framework. Many other researches have been conducted applying the socio-technical approach however their aims and conclusions were not that different from the ones this research has just cited; works like "Evaluating Factors Affecting Broadband Adoption in Kenya" by Mugeni et al. (2012), "Broadband and mobile opportunities: a socio-technical perspective" by Sawyer et al. (2003).

What is notable in most of these works it that the conclusions they reached are country or region specific and hence their recommendations are location based. This supports the approach that this research has taken; to consider SADC as its case. Nonetheless, the above researches except for Trkman and others, do not come up with a framework structure which although it can be used to in specific cases but remains generally applicable to any case in different context. Such an adaptable framework can be a useful tool for policy makers.

Another major shortcoming in most of these researches is the fact the frameworks suggested by researchers, though very useful, they are mainly concerned with micro level application which is mostly at organisational level. They lack a national and international scope, they falter at macro level as is discussed in section 2.5.4.2.

This research contends that, in order that a researcher understands and applies socio-technical approach to any phenomenon, the researcher has to first understand fully the concept of socio-technical systems theory. For that to hold true, one has to understand where this theory inherits from. Notwithstanding the modifications one can propose to the original theory, it still remains necessary to fully understand the mind of the first proponents of the parent theory. The following section takes the reader on a journey that culminates with the current socio-technical systems theory under discussion.

2.6.3: Systems Theory

Among the theories that are used to study information systems, general systems theory is one example of a grand theory which can be used. However its usefulness is in that it is a super class of many other middle-range theories that are more focus on domains of research and can give better guidance to empirical enquiry that grand theories cannot do (Mavetera 2010). General systems theory gave birth other 'systems' theories like socio-technical systems theory, chaos theory and dynamical systems theory among others (Jordan 1998). In order that this research finds its theoretical bearing appropriately, it is important to introduce to the reader the concept of systems of general systems theory

This research uses Socio Technical Systems Theory (STST) to study and provide a solution to the challenges of broadband growth and penetration in SADC. However, STST inherits directly from General Systems Theory hence in order to build a continuous and coherent understand of Social Technical Systems Theory, it is necessary to part from General Systems Theory, through systems thinking and settle for STST.

According to Hjørland and Nicolaisen (2005), "a system may be defined as a set of social, biological, technological or material partners co-operating on a common purpose. System theory is a philosophical perspective of describing systems as abstract organisations independent of substance, type, time and space. Systems theories can be explained with respect to both ontological and epistemological views." The ontological aspect of it speaks elements, integrative levels or systems that make up the world. The epistemological view point to the whole with the interplay of systems to achieve their functions and goals. This is in sharp contrast to atomistic approach were objects are viewed and investigated individually and in isolation. Systems theory was developed from biology, whereby it is not possible to understand the phenomenon of, for example, the sexual reproduction of flowers separate from the functions of the insects. From this definition of systems and systems theory a conclusion can be reached that this approach looks at organisations as an ecosystem where everything affects everything else.

General Systems Theory (GST) is one of the versions of Systems Theory. GST is particularly an approach in philosophy of science, aiming at understanding and investigating the world as sets of systems. Systems approach is a methodology or procedure in which problems are solved from a

holistic perspective, not as bundles of small isolated problems combined together (Bertalanffy 1962). The same view of systems approach was echoed by Checkland (1981:5). Kay and Foster (1999) defined the term "systems approach" as referring to procedures for problem solving and design within the context of systems thinking. In his own words Bertalanffy wrote:

"... this shows the existence of a general systems theory which deals with formal characteristics of systems, concrete facts appearing as their special applications by defining variables and parameters. In still other terms, such examples show a formal uniformity of nature." (Bertalanffy 1962).

On the other hand Luhmann (1976) contends that to be rigorous and consistent, systems theory should drop all reference to actors and their self-interpretations, which make up 'psychical systems' that form in part the environment for other systems. In this way, systems theory can be generally applicable to every level of social analysis. This approach to systems theory eliminates the atomistic and the subjective element in a system. In this research the terms "systems theory" and "general system theory" are used interchangeably since they stem from the same foundational principles.

Bertalanffy (1968) summarises the objectives of general systems theory in five points namely: "1. There is general tendency towards integration in the various sciences, natural and social. 2. Such integration seems to be centred in the in the general theory of systems. 3. Such theory may be an important means of aiming at exact theory in the non-physical fields of science. 4. Developing unifying principles which run 'vertically' through the universe of individual sciences, this theory brings us near to the goal of the unity of science. 5. This can lead to a much needed integration of scientific education"

As a recapitulation of what a system is and the application of systems theory, the following section enumerates the properties of any system as given by different scholars.

2.6.3.1: Systems Properties

Laudon and Laudon (1988) gave the following as characteristic that should define systems:"

1. A system has structure, it contains parts (or components) that are directly or indirectly related to each other.
2. A system has behavior, it exhibits processes that fulfil its function or purpose;
3. A system has interconnectivity: the parts and processes are connected by structural and/or behavioural relationships.
4. A system's structure and behaviour may be decomposed via subsystems and sub-processes to elementary parts and process steps.
5. A system has behaviour that, in relativity to its surroundings, may be categorised as both fast and strong."

In addition to the above system properties, Ackoff (1981), gave three concise properties of a system as follows: "

1. Each element has an effect on the function of the whole
2. Each element is affected by at least one other element in the system.
3. All possible sub groups of elements have the first two properties."

The two sets of system properties are complementary to each other and not contradictory. The Laudons used the word parts or components to refer to constituents that make up a system, whereas Ackoff use the word elements to mean the same thing.

In the reality space of this research the overall system is made up of three subsystems which are technology, society and environment. The three sub systems are at the same times systems on their own, however for the purposes of this research these are viewed as subsystems of one system. They are interconnected both in structure and behaviour in the sense that they physically interact and their activities inevitably influence each other.

A system is always more than just a sum of its parts but has what is referred to as emergent properties that do not exist in the parts but are found only in the whole (Weinberg 1975). These emergent properties are as a result of the behaviour of the system, made up of all these activities put together. It is in this regard that the broadband problem arises. Instead of the having one behaviour or purpose, variances are found which could be a result of lack of purpose harmonization. The favourable outcome in the utilization of broadband could 100% growth and penetration while at the same time business remaining profitable for investors: all this realized in

an environment that maintains an ecological balance between all the subsystems allowing for mutual adjustments of both technology and society. Furthermore, the emergent property of a system makes it extremely necessary for researcher using socio-technical approach to focus more on the macro level of broadband growth.

In order to describe a specific system one has to acquaint oneself with the following terms as discussed by Kramer and De Smit (1977):

- **Aggregate**: "A set of entities which may perhaps be partly interrelated, but in which at least one entity or subset of entities is unrelated to the complementary set of entities"
- **Entity**: "A part of a system: something that has objective or physical reality and distinction of being and character."
- **Relation**: "The in which two or more entities are dependent on each other."
- Structure: "Set of relations between entities; the whole of the relations."
- **State**: "The state of a system, containing the information on the system's earlier history and its present condition, is necessary and sufficient for predicting the output or the probability of a certain output, given a certain input."
- **Subsystem**: "An element or functional component of a larger system which fulfils the conditions of a system in itself, but which also plays a role in the operation of a larger system."

Checkland and Scholes (1999) further submitted that a system should survive changes in the environment and that survival is possible only when a system has processes of communication and control to adapt to changes in the environment.

After having known the properties of a system, the researcher needs to show how systems theory is linked to systems analysis and systems thinking

2.6.3.2: The Essence of Systems Theory

Systems analysis is the application of systems theory. One of the tools of systems analysis is systems thinking. Systems thinking looks at a system broadly, inclusive of all the structures, all the patterns and all the cycles in a system. This broad view helps one to quickly identify the real causes of issues in organisations and know just where to work to address them (Authenticity Consulting 2014).

Systems thinking differs from traditional ways of analysis in that the latter concentrates units that make a whole and analyses them in isolation to fix their individual shortcomings. However systems thinking focus on how constituents that make up a system interact to produce a behaviour of the whole which all units all units are a part of. The conclusion that can be reached by using these two approaches can be strikingly different especially when the system being studied is dynamically complex with lots of feedback from different sources, both internal and/or external.

2.6.3.3: Areas of application of Systems thinking

Aronson (1998) identified four major areas where systems thinking becomes a more optimal tool to use compared to the traditional analysis of problems. The areas are:

1. Complex problems that have many actors in order to see the bigger picture
2. Persistent problems or those problems that have become worse due to previous attempts to solve them.
3. "Issues where an action affects or is affected by the environment surrounding it. This could be natural environment or competitive environment."
4. "Problems whose solutions are not obvious."

All these four problem areas as identified by Aronson (1998) fit in the problem domain of this research which is broadband growth and penetration. The phenomenon involves various players or actors which are society, technology, industry and government making up one ecosystem. The relations of these are complex and multivalent. The issues that make up the problem statement are recurrent and past attempts fix them have compounded the problem. The environment is both policy centric and market driven. As a result the solution to the question of broadband growth and penetration is not obvious. The motivation behind the analysis of systems theory that this research has done so has been to find perspective of looking at socio-technical systems theory (STST) as a specialisation of systems theory. The following section introduces to the reader the STST as the lens through which the question of broadband growth and penetration has been addressed in this research.

2.6.4: Socio-Technical Systems Theory (STST)

The purpose of this section is to explore socio-technical theory in general in terms of design, influence of the environment and technology of any work unit or organisation but first some history and background of STST.

2.6.4.1: History and background of STST

Socio-technical systems theory was first developed at the Tavistock Institute of Human Relations in London. This approach to work design has since spread to developed countries in a short space of time. In Scandinavia and most parts of Europe, STST "is almost synonymous with work design and employee involvement"(Appelbaum 1997). Canada and the USA have embraced STST as an ultimate approach to work design (Cummings 1993). In the recent years there seems to more frequent reference to STST given the inevitable infiltration of technology in industries and work places. More recently, there seems to be frequent reference to STS, given the inevitable infiltration of technology into organisations in all industries. Often though, STS approaches appear to be fragmentary and only loosely reminiscent of the original theory (Cherns 1986). This is due to the level of demand by STST analysis and design. Most importantly, the non-holistic application of the STST to no application at all especially in government departments is due to non-availability of a comprehensive tool to aid decision makers in implementing and monitoring adherence to STST. This void would be filled by the outcome of this research, at least in part. Socio-technical systems are categorised in levels according to the scope of work they address.

2.6.4.2: Levels of Socio-Technical Systems

According to Trist (1981), Socio technical studies can be done in three broad levels which range from micro to macro levels, each of which is interrelated. The following is the description of the three levels by Trist: "

1) *Primary work systems.* These are the systems which carry out the set of activities involved in an identifiable and bounded subsystem of a whole organisation-such as a line department or service unit (*Miller* 1959). They may consist of a single face-to-face group or a number of such groups together with support and specialist personnel and representatives of management plus the relevant

equipment and other resources. They have a recognised purpose which unifies the people and the activities.

2) *Whole organisation systems.* At one limit these would be plants or equivalent self-standing workplaces. At the other they would be entire corporations or public agencies. They persist by maintaining a steady state with their environment.

3) *Macro-social systems.* These include systems in communities and industrial sectors and institutions operating at the overall level of a society."

This research focuses on the macro-social systems in the sense that it targets an overall level of society, specifically the SADC community. However in reality this research transcends all the three levels mentioned given the fact that it proposes a framework as its outcome. This framework is applicable to both the micro-level of systems as well as the macro-level. The basic design principles of socio-technical systems remain the same in spite of the level of the system in question. These principles can easily cascade to the micro systems units if they are entrenched in policies at macro level which in turn are meant to inform organisational policies.

Congruent with Trist (1981), as history of society unfolds people change in values and their expectations concerning work roles change as well. This changes the parameters of socio – technical design even though the principles may remain the same. Conversely, changes in technology change people's values and all other aspects of their live. Therefore socio-technical phenomena are contextual, necessitating the need for inquiry and survey before designs can be done in earnest, especially at macro levels.

2.6.4.3: The concept of Socio-Technical Systems Theory (STST)

Socio-technical systems theory is one such systems approach that "focuses on the interdependencies between and among people, technology and environment." (Cummings 1994). This approach seeks to optimize both the social and technical elements of an organisation or work unit. Socio-technical system theory is based on the premises that an organisation or a work unit is an intrinsic combination of social and technical elements and that it is open to its environment (Trist, Higgin, Murray & Pollack 1963). Owing to the fact that both "social and technical elements must work together to accomplish tasks, work systems produce both physical products and

social/psychological outcomes" (Appelbaum 1997). In light of this, the main agenda that answers to STST is to design work in such a manner that the two parts yield positive outcomes. This is called joint optimization according to Appelbaum (1997). This approach to business is in contrasts with traditional methods of doing business. In the traditional approach, the technical elements are designed first and then fit people to it. This method has often led to mediocre performances at high social costs.

Socio-technical approach has had a wide spread application due to its generality and so has the capacity to be "adopted with ease to almost any organisational situation... and remains open to continual improvement and revision" (Hackman & Oldham 1980)

The coordination between human and technical activities can only be successful and meaningful if one system is supportive of the other (Hackman & Oldham 1980). Owing to the interdependence of all systems, a change in one systems affects inevitably the other systems (Harvey & Brown 1992). The social subsystem of the overall system targets at coming up with a work design that answers to the psychological needs of the employee. It also gives the worker a sense of belonging and responsibility for the outcome of the work itself. This is according to Cummings (1994).

One other indispensable fact about socio-technical systems is that they are open systems (Emery & Trist 1965). This means that the system is open to the environment and therefore changes in the environment affects the system goals. These changes in the environment should be accommodated by the system in the least disruptive manner possible (Appelbaum 1997).

In conclusion to this section it is expedient to point out that technological improvements on their own do not necessarily mean high productivity nor high performances. Inherent to technological systems is the social system and the latter needs to be supportive of its members (Cummings 1997). In line with the thinking of Cummings (1981), the work environment needs to have semi-autonomous work groups to enhance productivity sense of ownership among worker is a socio-technical environment. Give the many aspects of socio-technical systems, it is therefore necessary to encapsulate the aspects of it in principles. Cherns (1986) gave principles of Socio-technical system design as follows:"

1. Overall productivity is directly related to the system's accurate analysis of social and technical needs and requirements. 2. An accurate analysis of the social and technical needs usually leads to work designs with the following characteristics:

• Minimal critical specification of rules – this principle has two aspects, negative and positive. The negative simply states that no more should be specified than is absolutely essential; the positive requires that we identify what is critical to overall success. In practice this means the work design should be precise about what has to be done, but not how to do it. The use of rules, policies and predefined procedures is kept to the absolute minimum.

• Variance control – variances, or deviations from the ideal process, should be controlled at the point where they originate. This recognises each individual as the first line of defence for his or her respective core tasks and the manager as the first line of defence for most boundary- related tasks.

• Multi-skills – each member of the system should be skilled in more than one function so that the work system becomes more flexible and adaptive. This allows a function to be performed in many ways utilising different people.

• Boundary location – roles that are interdependent should be within the same departmental boundaries. Interdependence may be a function of both knowledge and expertise. Boundaries are usually drawn on the basis of one or more of three criteria: technology, territory or time.

• Information flow – information systems should be designed primarily to provide information to the point of action and problem solving. This is in contrast to most systems, which provide information based on hierarchical channels.

• Support congruence – the social system should be designed to reinforce the behaviours intended by the new structure. Rewards, hiring practices, departmental structures, training systems, and so on all need to be congruent with the basic work design and work group structures.

• Design and human values – the design should achieve high results by providing a high quality of work life to fulfil individual needs. This is the very heart of STS theory. Superior results come from the joint optimisation of individual and organisational needs."

On the other hand Trist (1981) gave the following principles for socio-technical designs: "

1) The work system, which comprised a set of activities that made up a functioning whole, now became the basic unit rather than the single jobs into which it was decomposable.

2) Correspondingly, the work group became central rather than the individual job-holder.

3) Internal regulation of the system by the group was thus rendered possible rather than the external regulation of individuals by supervisors.

4) A design principle based on the redundancy of functions rather than the redundancy of parts (Emery, 1967) characterised the underlying organisational philosophy which tended to develop multiple skills in the individual and immensely increase the response repertoire of the group.

5) This principle valued the discretionary rather than the prescribed part of work roles.

6) It treated the individual as complementary to the machine rather than as an extension of it (Jordan, 1963).

7) It was variety-increasing for both the individual and the organisation rather than variety decreasing in the bureaucratic mode."

As the reader can observe that the above two sets of principles are almost identical save for variance control, and boundary location mentioned by Cherns (1992) but not mentioned by Trist (1981). In that context the two sets are complementary to each other. However one major shortcoming this research finds in these principles is the fact that they reduce the social aspect of the whole system to high quality of work life as pointed by Cherns (1992). This research proposes that true social value is unique and is far more than a high remuneration at work or just a cordial interrelationship in a work community. Important as this may be but the social element need to incorporate the history or a people, the culture, the demographics and many other societal factors as outlined in chapter 1. These factors should be as a result of research and consultation with locals or enshrined in a national policy. The thrust of Cherns (1992) and Trist (1981) is that technology shapes the society, this research contends that the shaping should be reciprocal such that technological advancement need also to follow the dictates of social values.

The two agree that the environment element of the STST is made up of the competitors and the market mainly, the researcher proposes that society is a major environment component and so is

the national regulatory framework (Kelly & Raja 2010). Organisational and company policies should answer to national agenda and hence should be enforced by national policy.

Appelbaum (1997) states that it is a common element among organisations to remain viable. Therefore organisations are naturally driven by making profit. However national agendas do not always lead to immediate profits if any at all. For this cause, some policies have to be monitored at national level lest organisation will simply not implement them.

2.6.4.4: STST Application to Broadband

According to Sawyer, Allen, and Lee (2003) perspective and with respect to broadband, STST is a solid framework for investigating the complex interrelationships of technical and social processes, given that the framework should include technological and social details of large-scale ICT projects.

From this perspective, Borgman (2000) conceptualized broadband as a socio-technical system. Sawyer et al. (2003) investigated broadband and mobile infrastructures from a socio-technical perspective. This approach to broadband is consistent with the concept of a broadband ecosystem introduced by Kelly and Raja (2010), in which broadband is a socially constructed artefact that is part of a cultural ecosystem. In a broadband context, STST addresses the social aspects of people and society, as well as the technical aspects of systems and technology. As a theoretical lens for broadband, STST enables the investigation of the technical subsystem (comprised of infrastructure, equipment, applications and service), the social subsystem (market, customers and industry), and the environment (regulation, policy and society) that are all critical components of a developing broadband society. The epistemological analysis of these determinants referred here to as subsystems should establish the underlying, hidden layer of reality that informs the relationships among these. This approach is purely the Socio-Technical theory approach.

2.6.4.5: Appropriateness of Socio-technical approach in this research

As already discussed, results of studies conducted in the recent past on broadband growth and penetration show the prevailing influence of GDP and economic development on the adoption of broadband. Studies of other possibly influencing variables have been inconclusive (Trkman et al. 2008). It is in these inconclusive studies that this research has its inspiration. The other influencing

variables of broadband are social in nature and require a socio-technical investigation to unearth their impact on broadband.

As opposed to the conventional economic model, the use of the socio-technical approach gives assurance that projects that are technological in nature give outcomes that are the result of a more complex interaction between technical and societal factors. "It is widely acknowledged that ICTs and the social and contextual settings in which they are embedded are in a relationship of reciprocal shaping" (Borgman 2000). Given this assertion, this research intends to investigate the relationship between Technology, Society and Environment within the context of SADC. Some researchers have spoken of broadband influencing or changing the culture of societies as Borgman (2002) says. This research argues that the shaping is reciprocal therefore society should speak to broadband as much as broadband speaks to society.

What is cardinal to note in the past studies that have emphasised the application of socio-technical systems theory to address the question of broadband growth and penetration is the fact that no real comprehensive and adaptive tool has been developed to help governments multinational companies to implement and monitor this approach. Especially tools that take in cognizance the context of a business setting with respect to societal differences brought about by variant backgrounds and histories of people groups. Even though this research pre-empts the importance of mutual shaping between technology and society, it is the researcher's submission that technology cannot and should not be placed at equal footing with societal values, therefore in spite of how useful and advanced technology can be, its meant to serve society and not for society to serve it.

The prevailing broadband frameworks, not only in SADC but globally largely lack the inclusion of societal uniqueness; culture, demographics, politics and much more as indicated in the proposed framework and how it relates to technology and its environment as an important part of the framework.

If the conventional economic framework model continues to be used uniformly in its current state among societies, we will not see much if any improvement in broadband growth and penetration especially among developing economies. As a result the digital divide and economic dichotomy between the first and the third world will persist. Now that the application of STST to broadband

growth and penetration has been qualified, the following section introduces the proposed socio technical framework for broadband growth and penetration

2.7: The proposed conceptual framework

The proposed framework for broadband growth and penetration is a system comprised of three as explained in section 1.5. The first component of the proposed framework is Fig 1.7 which is an interplay of three subsystems of STST plus one subsystem added by the researcher. These comprise the elements of the socio-technical theory save that a forth one has been added as separate entity; that is the industry element. The first proponents of the theory as studied earlier in this chapter used only three entities. However the researcher noting the determinant role industry is playing in relation to society, technology and the environment has taken it apart as a stand-alone entity. More importantly, if this research was just looking at the micro level of socio-technical theory then it wouldn't be appropriate to have industry as an entity on its own because then it would be just part of the environment. However, considering the macro level of socio-technical environment and with the understanding that industry is a stake holder in its own right whose interests and goals may be quite different from those of society and government, the researcher decided to analyse it as a separate entity forming part of the other three determinants of the theory.

Even though the four subsystems or entities shown in section 1.5 are meant to be a system exuding common behaviour with common goals and purpose, the reality suggests that there is no common goal. At a micro level it's easier to have a common goal because the focus will be on one organisation or company. However, when looking at national level or community level (macro level), society at large, has goals of its own which may not necessarily be consistent with the goals of individual companies or industry in general. In certain cases these goals may very well be antagonistic. That in essence defeats the principles of a system. Such a problem, when it touches broadband growth and penetration can manifest as poor growth and poor penetration of it.

This research therefore seeks to solve such a problem, not by continuing to employ traditional methods as explained in chapter one but rather by engaging the stake holders (Society, Technology, Industry and Environment) in a survey and apply socio-technical theory to address the disjuncture and increase broadband growth and penetration.

The epistemological analysis of these determinants referred here to as subsystems should establish the underlying, hidden layer of reality that informs the relationships among these. This approach is purely the Socio-Technical theory approach.

The second part of the proposed framework is a decision making tool, Table 1.3. This decision making framework is four dimensional as it relates broadband influencing factors, factors rank, type of intervention to be taken and the ration of the one intervention category to another.

While in the traditional business models the mind-set has been that with state of the art technology high production and performance is guaranteed, the reality shows that this is not necessarily so. The social aspect has to be addressed as well and fully. Hence the results of the survey on factors affecting broadband growth and penetration revealed in which area do member states in SADC require to concentrate there intervention. Not only did results indicate the areas of concern but the framework also assists in approximating the ratio of business policy to social policy required for every factor identified.

Table 1.4 speaks to the complexities of the socio-technical environment itself. The change from traditional models to the socio technical approach comes with its own repercussions. Relationships are not automatically, support is needed continuously, knowledge of experts is not explicit but tacit, meaning it only truly be transferred by spending time with the expert and many inherent properties of the socio-technical environment. Good leadership needs to pre-empt these challenges and prepare a contingent plan for solution. So, results of the survey also informed the framework of policies that need to be in place to address these challenges.

2.8: Conclusion

In conclusion, according to Trist (1981), the environment and technology always changes. These changes necessitate redesigning of the socio-technical environment. Therefore, the evolution of the socio-technical environment is unending and teams need to be always willing to redesign and adapt to the new environment, thus the system should be strong enough to withstand and adapt to changes and fast to move with times.

Much work has been done using STST as a lens for the research but no concise and comprehensive framework has been developed to help decision makers both at micro and macro level to improve broadband growth and penetration. This research sought to fill that gap. The prevailing economic model for broadband uptake lacks in that it considers broadband only as an economic tool and not as a social constriction that requires a necessary social attention as well.

CHAPTER 3: RESEARCH METHODOLOGY

3.1: Introduction

The aim of this chapter is to discuss the philosophical and methodological foundations for the chosen research plan. In other words this chapter focuses on how the research was done and why it was done that way. Since the research plan adopted in this research combines different methodologies based on different philosophies, it is expedient to describe the methodologies and the philosophies upon which they are based in detail.

Apart from describing the said, the chapter also explores the relationships between philosophy, research design and research methods or practices as depicted in Fig 3.1.

In section 3.2 the philosophies upon which social research is based are discussed and compared. These philosophies are positivism, interpretivism, transformative/advocacy and pragmatism. The backgrounds of these philosophical assumptions are explored in order to give perspective to the adopted research plan.

Research methodology is based upon a philosophy, philosophical stances form a continuum. Therefore, four main positions are largely discussed by the researchers and in this research. Positivistic, interpretive, transformative and pragmatic research methodologies are discussed in section 3.2.1 in the context of their applicability to this research.

The appropriateness of these adopted approaches is brought to light and the conclusion of this chapter is given in section 3.3. The detailed description of philosophical assumptions, design and methods used constituted the research plan for this work. Encapsulated within the design aspect of mentioned research plan is social research theory which is discipline specific. The application of the three mentioned aspects to this research is done in light of the primary research question: **how can Broadband Growth and Penetration (BGP) in the SADC region be increased** and the subsequent secondary research questions. The three main aspects of this chapter are i) knowledge

claims being made by the researchers, ii) strategies of research that informed the procedures and iii) methods of data collection and analysis that were used.

The following section explores philosophical underpinnings of social research in the main. Various philosophical assumptions are explored and their applicability to this research is examined. These philosophical assumptions are also referred to as knowledge claims.

3.2: Philosophy in Research

"Can I believe what I see? Do I see what I believe?" (Walliman 2014).

According to Walliman (2014), our whole life revolves around our philosophical approach to it, whether we believe it or not. Therefore, everyone is a 'philosopher', everyone has his/her own concept of the world. From this perspective we can define philosophy as one's perception of the world. The alternative to philosophy according to Collier (1994:16), is not the absence of philosophy but bad philosophy. Therefore, a person who says he/she is not a philosopher has an unconscious philosophy which they apply to their practice of whatever they do in their daily lives. This shows how inevitably the philosophical disposition of any researcher influences the way he/she conducts research. In any research work it is required that the researcher takes a conscious stance with regards to the nature of knowledge, its quality, acquisition, analysis and certainty of the conclusions that can be drawn from it. Researchers cannot assume that their positions in research are universally shared by their readers, therefore the need to make their philosophical approach clear.

The purpose of research is to find new knowledge about the world. Epistemologically one can argue that all knowledge is discoverable and can be tested using defined methods. Hughes (1990:10) states that it is not always easy to find out what these methods or procedures are. When these methods are applied as a set one can ask why one set of methods was preferred over the other for conducting research. The answer to such questions can only be found in the epistemological and ontological assumptions made for each set of methods. Hughes (1990:11) argues that "every research tool or procedure is inextricably embedded in commitments to particular versions of the world and to knowing that world". By saying 'particular versions of the world' he points to ontology or what makes up one's reality space and by 'knowing that world' he points at

epistemology that is knowledge about the entities in the reality space. This means that the effectiveness of any methods or procedures applicable to a particular research depends these two philosophical assumptions.

Different ontological and epistemological views by different philosophers have given rise to differing research models or philosophies. There is wide spectrum of attitudes or positions about research being debated today. The two opposing camps are positivist and relativists at the extremes, but there is a number of stances in between these two. In this research the following are discussed; namely: post-positivism, constructivism, transformative and pragmatism. Knowledge claims that the researcher espouses constitute the philosophical assumptions the researcher brings to the research. Such assumptions give the foundations and basis for the methodology adopted, the research design and the methods of practice.

Before linking the above elements of research together to give the research approach which can be either quantitative, qualitative or mixed, it is necessary to define methodology and how it differs from methods and procedures.

3.2.1: Research Methodology

The term methodology can be used generically as a systematic way carrying out a task at hand. Various authors use it differently. Rajasekar, Philominathan and Chinnathambi (2013) define research methodology as the "procedures by which researchers go about their work of describing, explaining and predicting phenomena". This definition falls short of the basis of the methodology. Procedures can as well be prescripts to be followed void of the philosophy of the researcher.

Harvey (1990) defines research methodology as the interface between methods, theory and epistemological underpinnings. This definition is schematically correct even though it does not expose the relationship between methodology and the other layers mentioned in the definition.

Sapsford (2006) defines research methodology as "a philosophical stance of worldview that underlies and informs a style of research". This definition is supported by Neuman (2000) who called philosophical assumptions, research methodologies. The above definition by Sapsford (2006) is the definition adopted by this research because of its completeness.

Having established that research methodology is inextricably linked to philosophical assumptions or knowledge claims, it is necessary to explore these claims in order to locate this research among them. Creswell (2014) advances the argument that there are four main schools of thought about knowledge claims. These are post-positivism, constructivism, transformative and pragmatism.

Owing to the fact that this research used mixed methods as its approach, it follows that it advances different philosophical assumptions or knowledge claims as transcendental to each approach used. In the next section, the justification for adopting mixed methods approach is given. Even though mixed methods approach is directly linked to pragmatism as its philosophical grounding, it is justifiable to identify the different philosophies involved in it and the aspects of this research which are informed by such philosophies. Therefore, the following descriptions of the various knowledge claims is done to highlight the research aspects informed by them.

3.2.1.1: Post-positivism

This knowledge claim is based on the thinking after positivism which challenges the idea of absolute truth. This understanding was brought to light in the 19th century and has been reiterated by other writers such as Phillips and Burbules (2000). The understanding this notion is that researchers cannot be "positive" about their assumptions when dealing with human behaviour. In this paradigm and according to Creswell (2014) five key assumptions are salient and these are:

Firstly, that "knowledge is conjectural", meaning that one can never find absolute truth about anything. Research evidence should be regarded as fallible and imperfect. It is because of this, that scientific research does not prove hypotheses but rather indicates the failure to reject.

Secondly, research process is iterative, starting with testing a theory, applying it to new situations then rejecting claims that don't hold true. Making new claims and testing them again, thereby perfecting the claims. Quantitative research has its basis in this paradigm.

In this knowledge claim, it is evidence found in data and rationale conclusions that creates new knowledge. The forth assumption is that variables are used to describe causal relationships among them. This is typical of experiments in quantitative research. And lastly and fifthly, objectivity is central in this paradigm. The research process should be rid of all bias, hence validity and reliability are essential standards in quantitative research.

The main question for this research is how can broadband growth and penetration be increased in the SADC region? To fully dissect this problem one has to look at the factors that influence broadband growth and penetration. The causal relationship between these factors had to be examined. Ranking of these factors needed to be done to fully understand and implement measures that promote broadband growth and penetration. These variables required a purely statistical analysis as a constituent solution to the posed question of broadband. Of course the said analysis did not provide a complete solution on its own. The point in question here is that this part of the research was purely quantitative and came grounded in the post-positivism paradigm.

Apart from collecting quantitative data and analysing it quantitatively using statistical tools, this research in the main is qualitative for two reasons. Firstly because the survey used to collect data combines both quantitative and qualitative responses of open ended interview type of questions. Furthermore, coupled with the survey are interview conducted separately and individually. The interview approach is entirely qualitative. These qualitative data was analysed qualitatively using qualitative analysis tools as is described towards the end of this chapter. Secondly, even if part of the data that was collected quantitatively and analysed as such it is in essence qualitative in nature. Researchers argue that a research approach is more than the tool used to collect data. Therefore using surveys does not necessarily, absolutely render the research quantitative. It is at the backdrop of the said three reasons that this research also adopts a qualitative approach. The following paradigm informs such a research approach.

3.2.1.2: Constructivism

This paradigm is often combined with interpretivism according to Merten (1998). At the core of this knowledge claim is the assumption that knowledge is a socially constructed artefact. The first proponents of this are Mannheim, Berger and Luckmann (1967) through their work "Social Construction of Reality".

According to Crotty (1999) and Creswell (2014), constructivism has purports three main assumptions, which are the following:

Meanings are socially constructed artefacts. Humans create meanings as they interact with their environment and with each other. Qualitative researchers use as their tool for evidence gathering, open ended question which allow participants to freely express themselves.

Secondly, human beings interact and make sense of their world based on their history and culture. Therefore it is essential that a qualitative researcher should understand the setting of the participants in order to make full meaning of the evidence gathered. The researcher then interprets the responses based on his/her own personal experiences and background. This makes the researcher, the researched.

Lastly, the process of qualitative research is inductive, meaning that it gives rise to meaning generated from gathered data. This results in a construction of theory as opposed to testing of theory as in post positivism.

This research locates itself well within this paradigm for the following reason: broadband is a social construction just as we evidenced in chapter 1 that there is no one definition for broadband as it varies one society to another. Socially constructed artefacts belong to the domain of constructivism. Moreover, the questions posed to participants appeal to every day way of life of the participants thereby requiring an understanding of meaning of such constructs like policy, economy, and cost, among many. The meaning to these are all socially constructed by communities and bestowed upon participants by culture and history. This makes the whole process of the research qualitative.

In spite of some of the survey questions being close ended, making them quantitative, the rationale behind the questions and the cognitive process of coming up with the response is largely qualitative. This is apart from the fact that the survey has to a large extent open ended questions, a trademark of qualitative research. Interviews were conducted both on skype and in person, this further augments the qualitative aspect of this research.

Given all the potency of the constructivist approach in this research, somehow there are areas of this work that are not adequately addressed by this approach. Issues of social justice as contained in this research are scarcely addressed by constructivism. The following section looks at a paradigm which seeks uncover social inequalities and empower the impoverished.

3.2.1.3: Transformative Worldview

This philosophical approach emerged in the 1980s and 1990s. The proponents of this worldview present an argument that constructivism does not go far enough to address the plight of the

marginalized in societies. Transformative writers have drawn from the works of Mark, Adorno, Marcuse, Herbemas and Freire, according to Neuman (2009). Most recent writers of this view include Kemmis and McTarggart (2000) and Mertens (2010).

In the core of it, a transformative view suggests that academic research should be intertwined with politics and political agenda to address social injustices, inequalities and suppressions wherever these are found (Creswell 2014). According to the same author, there is no uniform body of literature that explains this worldview but it's comprised of critical theorists, action researchers, ethnic groups, indigenous and post-colonial people among others.

Key assumptions that characterise this paradigm according to Kemmis and Wilkinson (1998) are the following: transformative actions are aimed at bring about change in practices. Therefore the researcher is expected to bring about an action agenda of change. It is concerned with empowering individuals from dominance and control of knowledge and educational settings. Transformative researches are also aimed at setting people from unjust and irrational structures that militate against self-development and self-determination. Such studies evoke political debate and a way to instigate change. In such advocacy research participants' lives are improved as they are incentivized to participate. The research is usually collaborative as it's done with the participants rather than on them.

How does this research draw from these philosophical assumptions? First and foremost and as discussed in chapter 2, broadband is seen as a public good. In most, if not all post-colonial societies, this public good has not been very public. The legacy of colonialism in most SADC countries left most people of colour marginalized and deprived of this public good. The affluent colonial masters of yester year stand advantaged from this legacy and such advantages still remain unaddressed by way of policies and practice. This research came up with a framework for broadband growth and penetration partly as a tool to address the consequences of colonial past. At the core of the proposed framework are policy interventions. These policies can be viewed as action agenda for change as presented in this worldview.

The digital divide between developing and developed economies still persists and it is a fact that high absorption capacity of broadband of a nation leads to its high economic index. The empowering ability of broadband among nations can never over emphasised. This is in line with

the transformative worldview in that at its core is the removal of constraints from previously disadvantaged people.

The above knowledge claims of the transformative worldview are rather radical and well suited for this research but in essence they are an extension of constructivism save that they go further to the emancipation of the disenfranchised of society. A research work that encompasses all the three philosophical positions discussed above exhibits its affinity for freedom to use whatever tool works to provide a solution to a problem. Such an approach is called pragmatism.

3.2.1.4: Pragmatism

There are many forms of this philosophy but in the main it is concerned with actions, situations and consequences instead of preconditions as in post positivism (Patton 1990). In this paradigm what works and provides solution to the problem at hand is the best. Hence instead of focusing on the methods, researchers are more concerned with the problem and use all available approaches to fully understand the problem in question (Rossman & Wilson 1985) . According to Morgan (2007) and Tashakkori and Teddlie (2010) this philosophical approach serves as an underpinning for mixed methods which is a pluralistic approach to research which employs different methods in order to fully understand the research problem. Congruent with Cheryholmes (1992) and others, pragmatism has the following salient points:

Pragmatic researchers pay no allegiance to any one philosophical position or reality (Creswell 2014). This informs mixed methods research which uses both qualitative and quantitative research approaches. In this paradigm researchers are driven by their needs and purpose to choose any methods, techniques and procedures. This gives researchers the liberty to use any tools for data gathering and analysis. Truth is what works at the moment independently of the dichotomy between the ideal and the real. Research in this paradigm is concerned with the 'what' and 'how'. This worldview acknowledges that research occurs in social, historical, political and other contexts. In this research pragmatism is the paradigm that was used and because this incorporates the other three paradigms, it has been necessary to explain each one of the separately.

3.2.1.5: Approach and strategies used

There are basically three approaches to research; quantitative, qualitative and mixed methods approach. For each of these approaches there are research strategies applicable. For example in quantitative research, experiments or surveys can be used as strategies, in qualitative research approach, case studies, ethnographies, phenomenology, narrative or grounded theory strategies can be employed and in mixed methods approach, sequential, concurrent or transformative strategies are used.

This research used a mixed method approach for the following reasons; since all research methods have limitations, biases in one method can neutralize biases in the other method thereby achieving methods convergence (Jick 1979). Secondly, when one method is nested within another method, this provides greater insights into different units of analysis Tashakkori & Teddlie 1998).

Concurrent procedure was used in the research as both qualitative and quantitative data were collected at the same time. This gave a much more comprehensive analysis of the research problem. The results of both data analysis were integrated in one informative outcome. This also helped analyse differently aspects of the research questions optimally.

The second strategy used within this mixed method approach was the transformative procedure. According to Creswell (2003), transformative procedure is when a theoretical lens is used to inform the research. Such a lens avails areas of interest, methods of collection of data, outcomes and possible changes anticipated by the research. This research has employed STST as its theoretical lens and this lens also provides the areas of interest namely, technology, society and environment. Implicit in these three determinants are the methods of data collection. Clearly in order to have an in-depth and rich knowledge of society, the researcher has to use open ended questions as in interviews yet numeric ratios between types of policies implementable can be obtained using close ended questions like in surveys. Social repercussions of broadband for example can be better captured in interviews rather than in questioners. Therefore with the used theoretical lens, data collection methods are implicitly provide for. For these reasons the transformative procedure strategy were employed. However, it should be clear why this particular approach of mixed method was adopted in this research. The following subsection explains in detail.

3.2.1.5.1: Justification of the adopted research approach

This researched used mixed methods approach. Mixed methods approach has three distinct advantages over using either qualitative or quantitative approaches separately. Firstly mixed methods research, combines both qualitative and quantitative methods, this gives it the ability to address both exploratory and confirmatory questions within the same research (Venkatesh, Brown & Bala 2013). This advantage gives mixed methods gives a researcher ability to build theory and test it in the same research.

Secondly, mixed methods have the ability to give stronger insights and inferences than single approaches on their own. (Tendlie & Tashakkori 2009). These meta-inferences are much richer conclusions than can be reached from one method.

Lastly, mixed methods gives room for divergent or complimentary views of the phenomenon under study by the different sets of data. This helps the researcher to reconsider or re-examine the theoretical framework or assumptions used for the methods employed.

Creswell and Clark (2007), Mingers (2001), Ridenour and Newman (2008), Teddlie and Tashakkori (2009) submit that there is a general agreement among researchers that the choice of using a mixed method approach should be mostly driven by the research question, objectives and context of the research.

This research used mixed method approach because of the inconclusiveness of one approach. The main aim of this research was to come up with a broadband growth and penetration framework for SADC. The proposed framework is made up of various components some which can only be analysed quantitatively and others qualitatively. This informed the choice of the research approach adopted. This is further justified by Morse (1991) and Creswell (2014)

Scholars such as Morse (1991) and Creswell (2014) among others concur that there are three main variables that determine the choice of a research approach. These variables are firstly, the match between the research problem under examination and the approach to be adopted, secondly, the personal experiences of the researcher and lastly the audience to whom the research is writing.

In examining the last two variables it is evident that some researchers are more acquitted and interested in emancipatory or advocacy writing; they pander to the needs of the disenfranchised and marginalized people. This approach to writing is an extension of qualitative approach hence the choice becomes obvious. This research did not use this variable alone to choose its approach.

Rather this variable, in this research has a far less weighted contribution to the choice of approach. This is so because the researcher is building his research carrier and versatility is key.

The third variable is the audience the researcher is writing to. This is more applicable in the event where one is writing to specific journals, conferences or graduate committees, where specific research approaches are expected. However this research being a thesis is not limited by these standards.

It is in the first variable; the match between the research problem and the approach that a detailed analysis was done and an approach adopted. This variable is the same as was highlighted by other researcher as the research questions, objectives and context. Let's look at the research questions:

The primary research question is:

How can Broadband Growth and Penetration (BGP) in the SADC region be increased?

The secondary research questions are:

1. What factors influence broadband growth and penetration in SADC?
2. Which influencing factors correspond to each sub systems of the Socio Technical Theory (STT)?
3. How do the factors identified conform to gathered data?
4. What interventions are needed to increase BGP in SADC?
5. How do business and social policy interventions per factor relate?
6. What are the most influencing factors of BGP in SADC?
7. What social repercussions are caused by socio-technical environment?
8. How can the social repercussions and Socio-Technical environment attributes be addressed?

Questions 1 through 6 can all be answered quantitatively according to the survey instrument and analysed as such using SPSS. Questions 1 and 3 seek to confirm using data what literature already says. Question 2 categorises the factors according to the socio-technical systems theory used in the research. Questions 5 and 6 were also answered quantitatively using statistical tools. However, questions 7 and 8 were answered qualitatively through interviews and analysed using Atlas.ti. The combination of both sets of results gave a much deeper and richer understanding of the problem and provided comprehensive insights for resulting BGP framework for SADC.

It is in the nature of these research questions that a case was made for adoption of mixed methods approach in this work. This justifies mixed methods in this research. Mixed methods approaches serve various purposes. Creswell (2003) and other scholars came up with seven possible purposes for which one can use mixed methods approach.

3.2.1.5.2: Purpose of mixed methods

This research used mixed methods for two main purposes which are complementarity and completeness.

Complementarity

This when mixed methods are used in order to gain complementary views about the same phenomena or relationships (Soffer & Hader 2007). An example would be when a qualitative study is used to gain additional insights on the findings from a quantitative study. In this research the phenomenon under study is broadband framework. The quantitative study identified the factors that influence its growth and penetration, it also ranked the factors, identified type of policy interventions for each factor and the ratio of these policy types per factor. The qualitative part of the research looked at same factors in form social repercussions and attributes of the socio-technical environment. As is revealed in chapter 4 of results and analysis, though not all factors as identified quantitatively emerged in the qualitative study, most of them resurfaced even though by other names. In a way this served as a corroborative purpose. Additional factors were identified and specific policies were discussed per factor unlike in the quantitative study where only policy types per factor were identified. These two sets of data complemented each other as they are both necessary components of the proposed framework.

Completeness

This when mixed methods designs are used to make sure a complete picture of a phenomenon is obtained. The qualitative data and results provided rich explanations of the findings from the quantitative data and analysis (Venkatesh et al. 2013). While the quantitative results mentioned social policies, qualitative results explained what the social policies were and how they would apply. Quantitative results showed that for broadband penetration more social policies are needed

than business policies per factor and the qualitative results went further to identify the actual social policies per factor, needed.

The resulting framework for broadband growth and penetration would not be complete by only confirming the factor, ranking them and giving the ratios of policy interventions needed. I was necessary to consider the socio-technical environment as a whole in terms of its attributes and repercussions and suggest actual policies that can address these factors.

The following table 3.1 summarizes the seven purposes for mixed methods research. This table has been included to illustrate all the seven purpose for mixed method research and to underline complementarity and completeness as the main reasons for adopting mixed methods approach in this research. A single research may not utilise all the purposes though it is possible to have more than one purpose of using mixed methods approach in one research.

Table 3.1: Purposes of Mixed Methods Research

Purposes	Description	Prior IS Research	
		Examples	Illustration
Complementarity	Mixed methods are used in order to gain complementary views about the same phenomena or relationships.	Soffer and Hader (2007)	A qualitative study was used to gain additional insights on the findings from quantitative study.
Completeness	Mixed methods designs are used to make sure a complete picture of a phenomenon is obtained.	Piccoli and Ives (2003) Hackney et al. (2007)	The qualitative data and results provide rich explanations of the findings from t quantitative data and analysis.
Developmental	Questions for one strand emerge from the inferences of a previous one (sequential mixed methods), or one strand provides hypotheses to be tested in the next one.	Becerra-Fernandez and Sabherwal (2001) Ho et al. (2003) Grimsley and Meehan (2007)	A qualitative study was used to develop constructs and hypotheses and a quantitative study was con- ducted to te the hypotheses.
Expansion	Mixed methods are used in order to explain or expand upon the understanding obtained in a previous strand of a study.	Ang and Slaughter (2001) Koh et al. (2004) Keil et al. (2007)	The findings from one study (e.g., quantitative) were expanded or elaborat by examining the findings from a different study (e.g., qualitative).
Corroboration/ Confirmation	Mixed methods are used in order to assess the credibility of inferences obtained from one approach (strand).	Bhattacherjee and Premkumar (2004)	A qualitative study was conducted to confirm the findings from a quantitativ study.
Compensation	Mixed methods enable compensating for the weaknesses of one approach by using the other.	Dennis and Garfield (2003)	The qualitative analysis compensated fo the small sample size in the quantitativ study.
Diversity	Mixed methods are used with the hope of obtaining divergent views of the same phenomenon.	Chang (2006)	Qualitative and quantitative studies wer conducted to compare perceptions of a phenomenon of interest by two differen types of participants.

Adopted from Creswell (2003), Greene et al. (1989), and Tashakkori and Teddlie (2003a, 2008).

Now that the philosophical underpinnings and the strategies associated with different approaches of this research have been explicated, before the introduction of the research design for this work, it is befitting to establish the relationship between philosophy, research design and research methods, which relationship gives raise to the overall research approach. This further justified the adoption of mixed methods approach in this research.

Although philosophy remains to a large extent hidden within research, it influences the practices of research (Slife & Williams 1995). Van de Walt (1014) calls these philosophical worldviews transcendental conditions. They are always present and shape the way of thinking of a researcher. The following schematic representation in Fig 3.1 shows how research practices are underpinned by philosophy. This research was informed by pragmatism as the researcher's worldview.

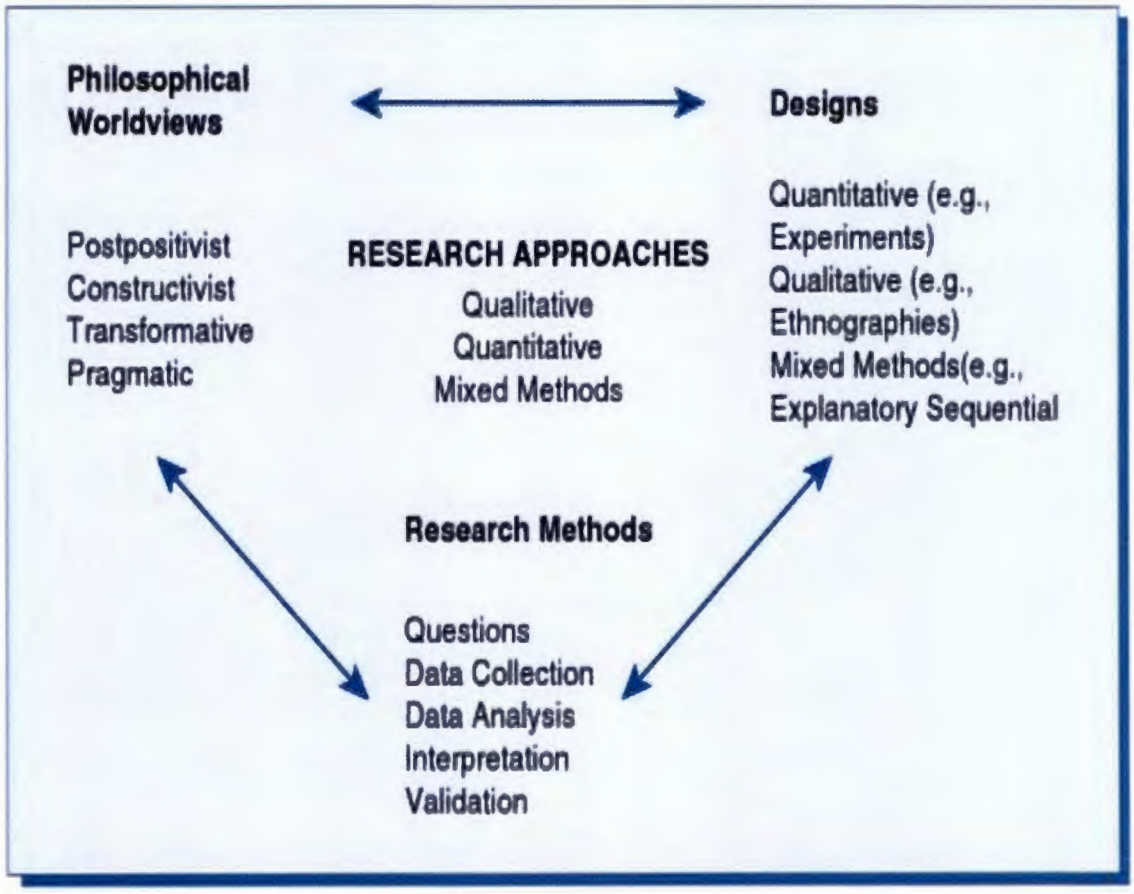


Fig 3.1: Framework for Research (Creswell 2014)

As explained in the in full in 3.2.1, for each of the four philosophical worldviews corresponds a specific research approach. However an approach is not definitive; between these approaches is a continuum of positions. Therefore research can never be said to be absolutely quantitative nor qualitative. Instead, research tends to be qualitative or quantitative, it's asymptotic and not exact, according to Creswell (2014). For each approach, however, there are specific strategies that are associated with it. Each strategy uses specific research methods applicable to it. This whole framework for research constitute research methodology. Even the though the above framework separates, for clarification purposes, research design from research methods; for all practical reasons, research methods are regarded as part of research design. The following section addresses the design of this research as inclusive of research methods.

3.2.1.6: Research design

According to Edmonds & Kennedy (2012) research design is the actual structure that shows the time frames in which data will be collected, when the intervention will be carried out or not and how many groups will be involved as participates in the data gathering.

Flick (2009) argues that search design is not only concerned with the knowledge of interest in a study, but also the contextual conditions, that shape a study (Flick 2009). Hence, research design is a plan for collecting and analysing evidence that will make it possible for the investigator to answer whatever posed research questions (Ragin 1994). Each research design has its pros and cons. To conduct this study, case study with concurrent and transformative procedures as explained in 3.2.1.5 were employed.

Case study is one "in which the researcher explores in depth a program, an event, an activity, a process, or one or more individuals. The case(s) are bounded by time and activity, and researchers collect detailed information using a variety of data collection procedures over a sustained period of time" (Stake, 1995). Case study investigates a phenomenon within its real-life context. Therefore, apart from cases being bounded by time and activity, they can also be bounded by space. In this research, the case is SADC and within this case are sub-cases which are member states of SADC. The design for this research involves data sampling that was used, tools of data gathering and methods of analysis that were employed to analyse the data.

3.2.1.6.1: Quantitative Sample

The target population for the research was SADC and probabilistic stratified random sample of participants in each member state was used. SADC has 15 member states at the time of this research. At least 10 member states responded to the survey. Within each state, random participants within focus groups were asked to respond to the questionnaires. The focus groups comprised of university students and middle to top management within organisations. This group of respondents was targeted because of the level of understanding needed to answer the questionnaires appropriately. Gay (1987) reports:

"Random sampling is the best single way to obtain a representative sample. No technique, not even random sampling, *guarantees* a representative sample, but the probability is higher for this procedure than for any other "(p. 104)

Mostly North West University students were chosen because of accessibility. These students come from many different SADC countries and so they responded to questionnaires in function of their respective countries. In this way many SADC countries were reached.

In line with sampling theory stratified random sampling is the most effective choice given the fact that the means of the stratified samples are more likely to be closer to the mean of the population as a whole (Robson 2002). Leary (1995) also submits that a stratified random sample typically reflects the characteristics of the whole population. The sample in this study was disaggregated by countries and further by universities and organisations.

The sample size was informed by three instruments; firstly, by recommendations made by Krejcie and Morgan (1970). These researchers suggested that at least 3% of the population should constitute the sample. A population according to De Vos et al (2009), is a set of all entities with all measurements of interest to the researcher. The same definition of population was echoed by Powers et al. (1985). This refers to all the people who had an opportunity to participate in the study. Therefore, the 3% mentioned by Krejcie and Morgan (1970), in this research refers to the university students and middle to top management of organisations for their ability to make sense of the questionnaire. While this recommendation is quite workable, its weakness is in knowing the population size for SADC.

The second instrument used to calculate the sample size in this research, is the sample size calculator. Using a population of 277 000000 people in SADC, a confidence level of 95% and a margin error of 5%, the sample size came up to 385.

Margin of error: How close to the "true value" is the answer given by the chosen sample. The smaller the error margin the better at a given confidence level.

Confidence level: The level of certainty that one has that the sample choosen represent the population per given margin of error. Researcher usually use the following standards: 90%, 95%, and 99%.

The equation behind the calculation of the sample size is:

$$Sample\ Size = \frac{\frac{z^2 \times p(1-p)}{e^2}}{1+(\frac{z^2 \times p(1-p)}{e^2 N})}$$

Where: Population Size = N | Margin of error = e | z-score = z

e is percentage, put into decimal form (for example, 3% = 0.03).

The z-score is the number of standard deviations a given proportion is away from the mean. To find the right z-score to use, refer to the table below:

Table 3.2 Sample size constants

Desired Confidence Level	z-score
80%	1.28
85%	1.44
90%	1.65
95%	1.96
99%	2.58

In this case the researcher used the total SADC population and compensated that by lowering the confidence level and/or increase the margin error.

Thirdly, SPSS recommends that for factors analysis there must be 5 to 10 subjects per variable. In this case subjects are respondents and variables are questions. The questionnaire survey for this research had 21 questions. Using the upper limit of the SPSS recommendation, this translated into 210 respondents. In considering all the three approaches, the researcher settled for 500 respondents. This took into account that accuracy of the results is greatly enhanced by increased sample size.

3.2.1.6.2: Qualitative sample

Generalisability is the ultimate goal of all good research in quantitative research (Marshall 1996). In quantitative research this is normally achieved by correct sampling techniques and good sample size. However, in qualitative research, a correct sample size is one that adequately answers the research question. Put simply, sample size in qualitative research is not as predictable in stepwise fashion as in quantitative research. The sample size in qualitative is adequate when data saturation is reached. This is when no new themes and categories are emerging during coding. In this type of research depth is more important than breath, so normally qualitative research sample size is small single digits. Understanding complex human issues is more important in qualitative research than generalisability of results (Jackson 1970).

There are three main categories of naturalistic sampling techniques in qualitative research. These are convenience sample, judgment sample and theoretical sample, according to Marshall (1996). Convenience sampling has the least rigorous of them all. In this approach, the research expends least cost in terms of time, effort and money. Therefore, it lacks intellectual credibility, thus this research did not adopt this approach.

Judgment sample takes various forms; maximum variation sample, deviant sample of outliers, subjects with specific experiences also referred to as critical case sample or experts subjects called key informant sample (Glaser 1968). This research used the key informant approach with snow balling in which informant were free recommend other informants.

Theoretical sample is used with grounded theory approach where interpretive theories are constructed from data and then verified using a different sample (Bradley 1992).

3.2.1.6.3: The instrument

This research used a survey questionnaire and interviews to gather data. The survey questionnaire used consisted of two sections. The first section comprised close-ended questions designed according to Suskie (1996) reliability standards that enables it to elicit consistent responses. This first part of the survey addresses four aspects of the research questions which are 1. Confirmation of the factors of broadband growth and penetration as given in literature. 2. Ranking of these factors. 3. Confirmation of interventions by way of policies, social and business, and 4. Ranking of these policies per factor. In designing the questionnaire, the researcher used guidelines as suggested by Leary (1995). These guidelines are outlined below:

1. Use precise terminology in phrasing the questions.
2. Write the questions as simply as possible, avoiding difficult words, unnecessary jargon, and cumbersome phrases.
3. Avoid making unwarranted assumptions about the respondents.
4. Conditional information should precede the key idea of the question.
5. Do not use double-barrelled questions. (Questions that ask more than one question but provide the respondent with the opportunity for only one response)
6. Choose an appropriate response format.

7. Pre-test the questionnaire.

The above guidelines were followed in designing the questionnaire to the satisfaction of the researcher. However, in order to ascertain the validity and reliability of the questionnaire a pilot survey was done. According to Suskie (1996) a researcher needs to take certain precautionary steps in order to enhance reliability and validity of a questionnaire:
"Have people with diverse backgrounds and viewpoints review the survey before it is administered. Find out if:

- each item is clear and easily understood;
- they interpret each item in the intended way;
- the items have an intuitive relationship to the study's topic and goals, and;
- the intent behind each item is clear to colleagues knowledgeable about the subject"

The responses obtained from this pilot survey indicated adherence to most the above checkpoints with exception of a few changes that had to be done to the questions.

The second section of the survey consisted of open-ended questions which address the complexities of a socio-technical environment. This emanates from the fact that such an environment comes with its own social repercussions. Questions in this section are entirely qualitative and seek to unearth social policy issues relating to the said environment.

3.2.1.6.4: Data collection using emailed survey

The survey was distributed electronically by email using Survey Monkey. This application sends the responses automatically to the research the moment a respondent finishes taking the survey. Robson (1993) presents that emailed surveys are extremely efficient in giving information in a short period of time without much expense to the researcher.

The researcher sent out the survey accompanied by a cover page that introduced the research objectives and a consent form outlining ethical issues which the participants could either agree with and take the survey or disagree with and not take the survey (Appendix A). In this context, the only proof of consent to the ethical conditions of the survey by participants was in answering the survey. No physically signed consent could be given as the survey was not sent to specific individuals via emails but rather to sampled groups via their common portals like common students' platforms in universities or group emails in companies. This approach further enhanced

the confidentiality of the participants. However, the researcher's contact details were made available to participants to enable clarifications of any issues unclear to participants. A week after the survey was sent out, a reminder email (Appendix B) was sent out to all targeted groups. Four weeks following the initial survey another reminder email (Appendix C) was sent to sample groups least responses. Then after another four weeks, a replacement survey (Appendix D) was sent to all the groups. According to Suskie (1996), such a timetable helps as an efficient way of reminding recipients to complete the survey without incurring much expenses. This also doubles the initial response rate which on average is about 40% at the inception of the data gathering process.

3.2.1.6.5: Interview design

There are various designs of interviews that a researcher can undertake in order to obtain thick and rich information from participants (Creswell 2007). However Gall, Gall and Borg (2003) highlight three formats of interview design which are (a) informal conversational interview, (b) general interview guide approach, and (c) standardised open-ended interview. This research utilised standardised open-ended interviews. Therefore, attention is solely given to it in this discussion.

In standardised open-ended interviews, participants are asked identical questions. The wording of the questions are in such a way that participants are allowed to express their viewpoints and their experiences as much as they desire. This approach also allows interviewers to ask follow up or probing questions as the interview progresses (Daniel & Turner 2010). The only weakness of this type of interview is that it becomes cumbersome and hence difficult for the researcher to sift through hordes of narratives in order to draw themes during coding, especially when this involves many participants. Although this can be regarded as a weakness, it is a strength at the same time because it reduces interviewer bias in analysing the data.

This research utilised standardised open-ended interviews. Creswell (2007) suggests that four things need underline a good interview design, which are, preparation for the interview, formulation of the interview questions, actual implementation of the interview and data analysis.

According to McNamara (2009) eight principles are applicable in the preparation stage of interviewing and are the following: (1) choose a serene location for the interview if it's a face to

face one; (2) tell the participate the aim of the interview; (3) Explain to the participant how he/she and the information they give will be treated with high confidentiality; (4) Describe how the interview is going to be help in terms of recordings and taking of notes ; (5) indicate the usual length of the interview; (6) tell them how to get in touch with you later if they want to; (7) ask them if they have any questions before you both get started with the interview; and (8) Prepare instruments to capture the interview. As part of preparing for the interview, participant selection pilot testing is necessary. These were the preparative steps that were done before interviews were carried out in this research.

With regards construction of question McNamara (2009) gave the following recommendations which saved as the guidelines for the researcher's interview questions: "(a) wording should be open-ended (respondents should be able to choose their own terms when answering questions); (b) questions should be as neutral as possible (avoid wording that might influence answers, e.g., evocative, judgmental wording); (c) questions should be asked one at a time; (d) questions should be worded clearly (this includes knowing any terms particular to the program or the respondents' culture); and (e) be careful asking "why" questions".

The second last aspect of interview design is the actual implementation of the interviews and McNamara gave insightful guidelines to follow: (a) occasionally ascertain that tape recorder is working if it is being used during the interview; (b) ask one question at a time; (c) be as neutral as neutral as is possible without showing strong reactions to the participant's responses as this might cheer them on and give information they think the researcher wants to hear or become despondent; (d) "encourage responses with occasional nods of the head, 'uh huhs', etc."; (e) take heed to appearances when note taking as this may influence future responses; (f) be clear about the change of topic or subject by directly mentioning it to the participant;" (g) always be in control of the interview by graciously control any digressing from the topic by the participant.

The last part of the design is the interpretation of the data or making "sense" of the information given. This involves the process of categorizing themes or codes. 'These themes or codes are consistent phrases, expressions, or ideas that were common among research participants" (Kvale 2007). In coding, various software packages can be used. This research used Atlas.ti. The above mentioned guidelines helped the researcher to conduct the interviews.

3.2.1.6.6: Data collection using interviews

Complementary to the survey were interviews that were mostly conducted electronically via skype while they were being recorded. These interviews, apart from addressing their own objectives, were done as a follow up to the responses obtained by the survey. Commonly participants become reluctant to giving detailed responses especially to open ended questions. So interviews were used to fill in the gaps. According to Jacobson (2009) interviews have the following advantages: they are useful for gaining insight and context into a topic, allow respondents to describe what is important to them and are useful for gathering quotes and stories. Furthermore it's much easier to seek clarification to response during an interview. They are also flexible such that interviewer can change the direction of question during the interview. An informal environment encourages participants to be honest and open. Interviews can be done both electronically and face to face where it's not possible to do electronic interviews.

Where these interviews were following up on the responses of the initial surveys, the procedure was sequential according to Creswell (2014) and where they addressed own objectives, the procedure was concurrent according to the same. In the main the interview were administered to people in management and strategic positions. This was so because of the nature of information the researcher was looking for in these interviews.

Mostly, in the interview the researcher's intention was to pre-empt the social repercussions that are inherent to a socio-technical environment and how those repercussion could be averted before they occur or dealt with after they have occurred. Obviously the solutions to such a problem largely lies in policy interventions. In view of this, experts and senior management participants were more likely to provide insightful information.

Prior to interviews, whether face to face or electronic, consent from the participant was first sought. This was done during the time of making appointments and reiterated just prior to the interview. The purpose, conditions of participation and how the information given will be used had to first be explained to the participant. It was made clear that the participant was to free withdraw from the interview at any time. So the interviews proceeded with recordings at every time. Such recordings too were known by the participant and agreed to before they could be done.

After each interview and while the information was still fresh in the researcher's mind, the recordings were transcribed, that is, put in written format. In vivo terms were used during transcribing. At this point the data was ready for analysis.

3.2.1.6.7: Methods of Data Analysis

Data analysis for this research was done in two phases. The first phase was the analysis of survey data using SPSS. This phase started of examining the surveys for correctness and completeness, i.e cleansing of the data and then keying it into the SPSS database. In accordance with the research questions 1 through 7, factor analysis part of SPSS was predominately used in this first phase. General analysis was done by survey monkey itself and part of that analysis that had significance in answering the research questions was incorporated into SPSS analysis results.

The second phase of the data analysis was for qualitative data largely obtained from interviews. Part of this data was from the open ended part of the surveys. This analysis was done using Atlas.ti. This process started with capturing primary documents into Atlas.ti. Coding then followed, which was the tedious part of all in this second phase. With themes established, more detailed analysis looking out for the lens of this research which is the socio-technical systems theory. The detail of this analysis was given in the data analysis chapter.

The whole research methodology as explained can be summarize diagrammatically by Fig. 3.2 below:

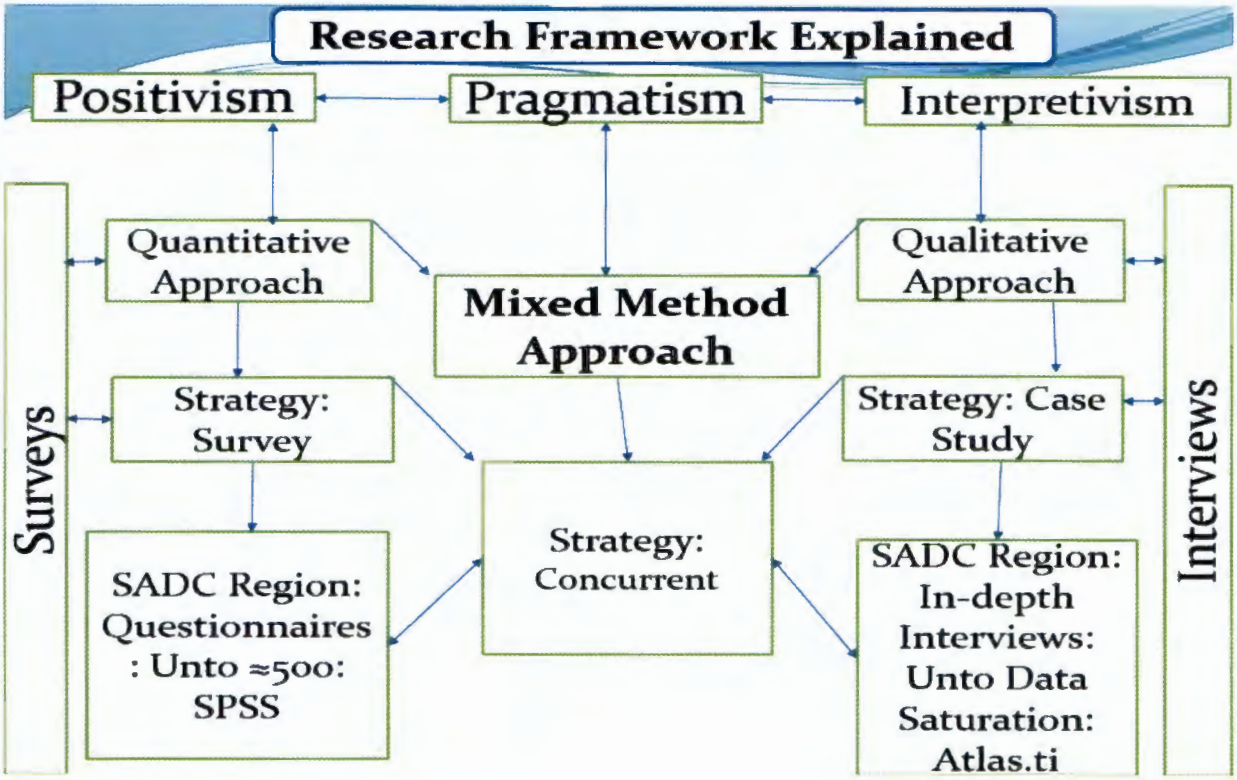


Fig 3.2: Research Framework

Fig 3.2 illustrates the philosophical underpinnings that informed the research approaches adopted, the strategies that were used, the data gathering tools and the sample sizes.

3.3: Validity

Validity is concerned with the integrity of the conclusions that are generated from a piece of research. There are many types of validity criteria; internal validity, external validity, and ecological validity (Bryman & Bell 2007). It is acknowledged that there is no agreed position on validity in so far as it applies to qualitative research, however, Venkatesh, Brown and Bala (2013) gave the following guidelines with respect to validation in both quantitative and qualitative as explained in section 3.3.1 below. The following validity applies to quantitative research component of this work.

3.3.1: Validity in quantitative research

Design validity

Internal validity relates mainly to the issue of causality. It refers to how well the collected data match the reality that they seek to present. One way of doing this is to use different sources of data and then triangulate (Yin 1994). This research used data triangulation, as data was obtained from various member states of SADC

External validity concerns with the possibility that the results of a study can be generalised beyond the specific research context. It is often argued that case studies impose constraints upon the external validity of the findings, given the explicit focus on a certain event (Yin, 1994). The results of this research may not be applicable to other regions of the world as they are specific to SADC. The resulting framework however, in its generic form can be used anywhere.

Measurement validity

Reliability: refers to repeatability or consistency. A measure is considered to be reliable if it produces the same result over and over again. There are various types of reliability, such as inter-rater or inter-observer reliability, test-retest reliability, parallel-forms reliability, and internal consistency reliability. This research used construct validity because factor analysis which was used in this research is concerned with convergence validity.

Construct validity: The degree to which inferences can legitimately be made from the operationalization in a study to the theoretical constructs on which those operationalization are based. There are many different types of construct validity, such as face, content, criterion-related, predictive, concurrent, convergent, discriminant, and factorial. Factor analysis which was used in this research is concerned with concurrent, convergent, discriminant validity. The researcher tested for convergence validity by calculating construct reliability (CR) for each variable. This was calculated for society, environment, technology, industry and the second order CFA, Growth-Penetration. The values of CR were tabulated together with those of average variance extracted (AVE).

Validity, in the context of a qualitative study, is defined as the extent to which data are plausible, credible, and trustworthy, and thus can be defended when challenged.

3.3.2: Validity in qualitative research

The qualitative component of this work involved the following validity: Design validity which speaks of how credible and transferable are the research results, based on how well was the design and execution of the research. Analytical validity is how well was the data collected and analysed to the extent that the results are dependable and plausible. Inferential validity speaks of the quality of interpretation of results to the extent that they be supported by other researchers

Design validity

Descriptive validity: The accuracy of what is reported (e.g., events, objects, behaviours, settings) by researcher. The details of how data was gathered was given in detail in the preceding sections.
Credibility: Involves establishing that the results of qualitative research are credible or believable from the perspective of the participants in the research to convincingly rule out alternative explanations. This was done by sharing results of the research with some participants and soliciting their comments.
Transferability: The degree to which the results of qualitative research can be generalised or transferred to other contexts or settings. The results of this research are not generalisable beyond SADC as it is a case study.

Analytical validity

Theoretical validity: The extent to which the theoretical explanation developed fits the data and, therefore, is credible and defensible. This was accomplished by confirmatory factor analysis.
Dependability: Emphasises the need for the researcher to describe the changes that occur in the setting and how these changes affected the way the researcher approached the study. No significant changes in the setting took place during the data gathering period for this research.
Consistency: Emphasises the process of verifying the steps of qualitative research through examination of such items as raw data, data reduction products, and process notes. Data cleaning was done to get rid of outliers.

Plausibility: this speaks to well the findings fit the data from which they are derived (Sandelowski 1986). This is similar to theoretical validity and factor analysis ascertained.

Inferential validity

Interpretive validity: The accuracy by which the researcher understands the responses given by participants. Their views, thoughts, feelings, intentions, and experiences need to be accurately understood by the researcher. Follow up questions were posed during interviews in order achieve interpretive validity.

Confirmability: The degree to which the results could be confirmed or corroborated by others. This was achieved by testing the output itself. The resulting framework was taken back to focus groups of experts to seek the opinion about the tool.

Ecological validity addresses the question of whether or not social scientific findings are applicable to people's everyday lives or natural social setting (Bryman & Bell, 2007). To accomplish this, cultural and ethical considerations were adhered to during the research in coming up with the framework.

Reliability

Flick (2009) characterises the discussion about reliability in qualitative research as coming down to the need for explanation in two respects. First, the genesis of the data needs to be explained in a way that makes it possible to differentiate between a statement of the subject, and the point at which the researcher's interpretation begins. Second, procedures in the field or interview and with the text need to be made explicit in training and rechecking in order to improve the comparability of the behaviour of different interviewers or observers (Orada2012). Coding is the process organising or categorizing data from the field and labelling these categories using "in vivo" terms (the actual language of the participant (Creswell 2009). This research used face to face interviews of IS experts from five different SADC countries. The interviews were by appointment and recorded before they could be transcribed into Atlas.ti for analysis of responses.

3.4: Validation applied to this research.

This section deals with validation of mixed methods research findings as a whole. Qualitative and quantitative research validation separately was dealt with in section 3.3. According to Teddlie and Tashakkori 2003) and (2009), validation in mixed method research is essentially examining the quality of the inferences or findings the researcher obtained both from qualitative and quantitative results. The most important assessment in validating mixed methods research is that of the meta-inferences.

The three cardinal elements to consider when validating mixed methods research congruent with Venkatesh et al. (2013) are integrative efficacy; that is, how effectively are the inferences integrated into meta-inferences, integrative correspondence; how meta-inferences are in accordance with the original reason for conducting mixed methods research and inference transferability. This speaks of the generalisability of meta-inferences beyond the context and setting of the present research.

Bryman (2007) submits that integrative efficacy does not mean that all inferences need to have exude a singular understanding of the phenomenon under investigation, rather the "quality of comparison, contrast, infusion, linkage, and blending of findings from both strands of mixed methods research". However, all the inferences should respond to the same main objective of the research. In this research the aim is to propose an evolutionary and adaptive broadband growth and penetration framework for SADC. Therefore, all the inferences point to this aim. All the meta-inferences established in this research findings blend, link, contrast and infuse each other.

In validating the inferences an integrative framework for mixed methods inference quality in Table 3.2 was used. All the inferences and meta-inferences made were assessed for quality using the framework.

The framework in Table 3.2 encompasses two major aspects of assessment; design quality and explanation quality. Design quality deals with design appropriateness, design adequacy and analytic adequacy. Explanation quality includes qualitative inferences, quantitative inferences and integrative or meta-inferences.

The mentioned inferences are theoretically consistent and integrate into building a theory, hence this research can be categorised as inductive. The resulting theory of the research is the proposed framework.

Table 3.3: Integrative Framework for Mixed Methods Inference Quality

Quality Aspects	Quality Criteria	Description
Design quality: The degree to which a researcher has selected the most appropriate procedures for answering the research *questions (Teddlie and* Tashakkori 2009).	Design suitability/ appropriateness	The degree to which methods selected and research design employed are appropriate for answering the research question. For example, researchers need to select appropriate quantitative (e.g., survey) and qualitative (e.g., interview) methodologies and decide whether they will conduct parallel or sequential mixed methods research.
	Design adequacy	***Quantitative***: The degree to which the design components for the quantitative part (e.g., sampling, measures, data collection procedures) are implemented with acceptab quality and rigor. Indicators of inference quality include reliability and internal validity (Shadish et al.

		Qualitative: The degree to which the qualitative design components are implemented with acceptable quality and rigor. Indicators of inference quality include credibility and dependability (Teddlie and Tashakkori) 2009).
	Analytic adequacy	***Quantitative:*** The degree to which the quantitative data analysis procedures/strategies are appropriate and adequate to provide plausible answers to the research questions. An indicator of inference quality is statistical conclusion validity (Shadish et al. 2002).
		Qualitative: The degree to which qualitative data analysis procedures/strategies are appropriate and adequate to provide plausible answers to the research questions. Indicators of quality include theoretical validity and plausibility.
Explanation quality: The degree to which credible interpretations have been made on the basis of obtained results (Lincoln and Guba 2000; Tashakori and Teddlie 2003b).	Quantitative inferences	The degree to which interpretations from the quantitative analysis closely follow the relevant findings, consistent with theory and the state of knowledge in the field, and are generalisable. Indicators of quality include internal validity, statistical conclusion validity, and external validity
	Qualitative inferences	The degree to which interpretations from the qualitative analysis closely follow the relevant findings, consistent with theory and the state of knowledge in the field, and are transferable. Indicators of quality include credibility, confirmability, and transferability.
	Integrative inference/ meta-inference	***Integrative efficacy:*** The degree to which inferences made in each strand of a mixed methods research inquiry are effectively integrated into a theoretically consistent meta-inference.
		Inference transferability: The degree to which meta-inferences from mixed methods research are generalisable or transferable to other contexts or settings.
		Integrative correspondence: The degree to which meta-inferences from mixed methods research satisfy the initial purpose (see Table 1) for using a mixed methods approach.

Adopted from Venkatesh et al. 2013

Table 3.2 above outlines the framework that the researcher used to come up with inferences and meta-inferences.

The process of validating mixed method research followed Fig 3.3 below. Each stage was iterative following the guidance of Table 3.2 above. The process would be repeated untill design, quality inference and quality meta-inference was achieved. Therefore the integrative framework in Table 3.2 was the foundation of the meta-inferences produced by this research. This way the process of drawing inferences and meta inferences was achieved by the researcher. The proposed framework

integrates both inferences from the qualitative and the quantitative results. The meta inferences speak to the whole proposed framework.

Apart from this validation process, the researcher sought comments about the usefulness of the proposed framework from two experts. These comments are on Annexure 1.

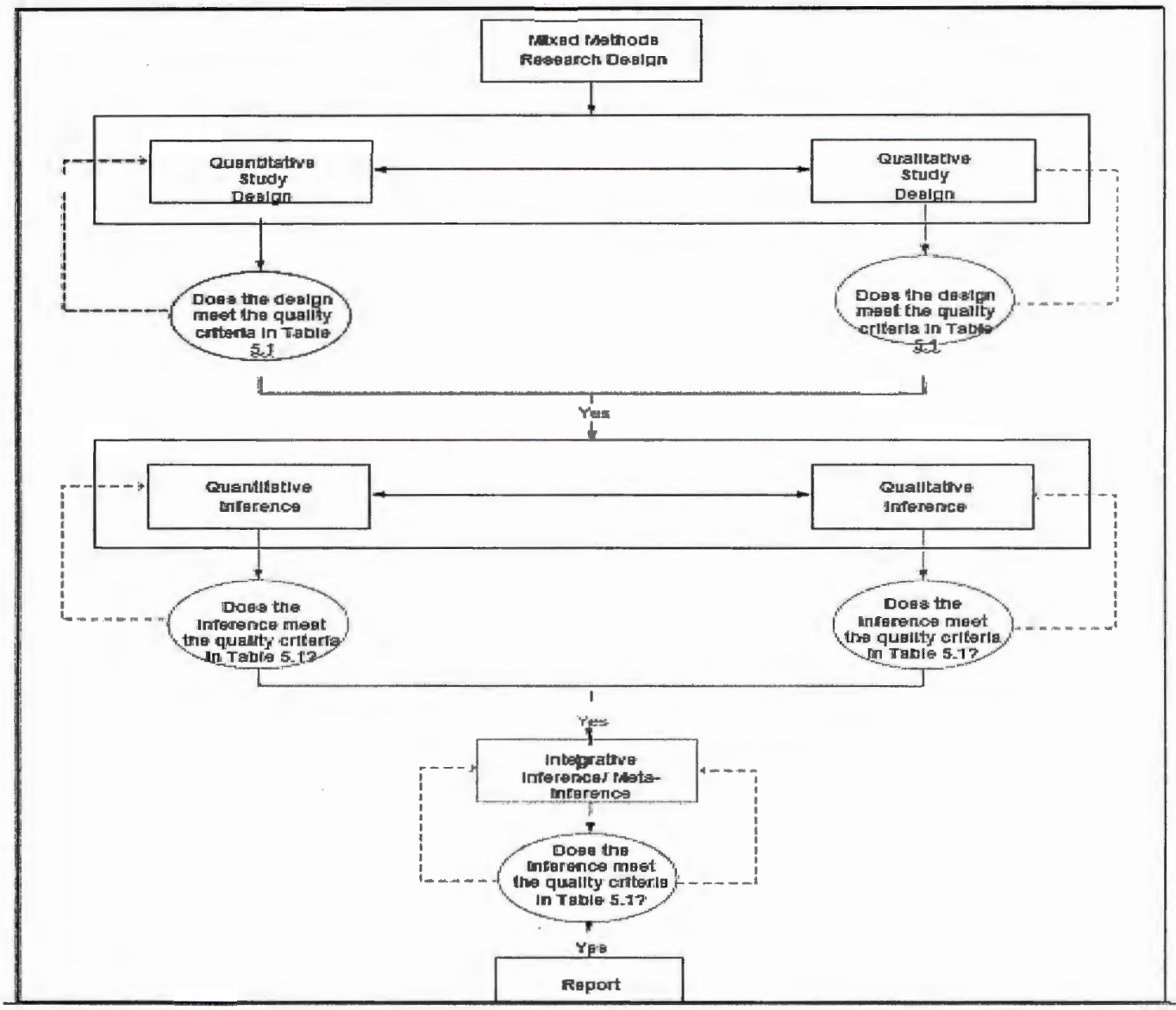


Fig 3.3: Process of Mixed Methods Research and Inference Quality (Adopted from Teddlie and Tashakkori 2009)

3.3: Summary

The purpose of this chapter was to discuss the methodology this research adopted (Philosophy as it informed the design, methods and approaches), explain how the sample was chosen and why, explain the procedure followed in designing the instrument of data collection and the collection of data itself. The chapter also provided the explanation of the statistical procedures for data analysis and the qualitative analysis of data, culminating in discussing validity in both quantitative and qualitative research. In conclusion the chapter gave the validity procedures applied to mixed methods in this research.

CHAPTER 4: RESEARCH RESULTS AND ANALYSIS

4.1: Introduction

This chapter presents data analysis followed by discussion on the research findings. Data analysis was done to identify, describe and explore the conformity of broadband growth and penetration factors as given by literature to the realities confronting SADC nations. Findings speak to the research questions, that is, the extent to which they have been answered or not answered. Data was obtained from 13 of the 15 SADC members states. A total of about 550 participants responded to the survey and 5 experts were interviewed.

The research applied a mixed method approach with concurrent strategies hence online surveys and interviews were conducted at the same time. The online survey contained both quantitative and qualitative questions, the last 5 questions of the survey were open ended.

In the presentation of the results, firstly the distribution by SADC countries of data collected is presented. This distribution of data serves as the basis for regional generalizability of the results of the research. Then, a phased approach of data and its analysis was given. The first part comprises of quantitative data and its analysis before the qualitative part.

After the qualitative results and analysis is given then a generalised analysis is reached in light of the combined results of the mixed method approach. It is important to highlight that at the end of every analysis of a dataset, context is given of its appropriateness to the overall proposed framework as discussed in the previous chapters. At the end of analysis of every dataset also reference is made to the research question or objective that analysis was attempting to answer. In this way findings were made as the analysis progressed.

The following section presents the objectives of this research together with the research questions. A stepwise approach to the analysis of research will help tick off each objective as it is met or not met, whatever the case may be. This will help the reader to not have to go back to chapter 1 every time to establish what research questions are being addressed at every stage of this chapter.

4.2: Research Aim, objectives and questions

The aim of this research is to propose an adaptive broadband growth and penetration framework for SADC.

This aim suggests a framework that should be adaptable to changes in times and space. This change may not be so much of its constructs as it is of its populating datasets. This becomes logical because research has shown that societies are not static but rather dynamic entities. Hence, the results we obtain today from a sample group may not be the same results in years to come even within the same or similar sample. The framework is adaptive because it can be used in any population group with the prerequisite of a survey or consultation

The objectives set out at the beginning of this research are the following:

- Determine the underlying latent factors influencing broadband growth and penetration in SADC.
- Categorise the factors of broadband growth and penetration into the determinants Socio-technical systems theory.
- Test the factors using data and Confirmatory Factor Analysis (CFA).
- Determine the categories of interventions required to satisfy the factors identified.
- Determine the ratio of economic policies to social policies needed per latent factor.
- Rank factors influencing BGP in SADC.
- Identify attributes and social repercussions that are caused by socio-technical environment.
- Identify policies that address attributes and repercussions of a socio-technical environment.

Each of these objectives corresponds to a research question which is answered as the objective was met.. The primary research question attempts to address the main aim of the research. The primary

research question therefore is: How can Broadband Growth and Penetration (BGP) in the SADC region be increased?

In answering this question the following secondary research questions were posed: 1. what latent factors are influencing broadband growth and penetration in SADC? 2. Which influencing factors correspond to each sub systems of the Socio Technical Theory (STT)? 3. How do the factors identified conform to gathered data? 4. What interventions are needed to increase BGP in SADC? 5. How do business and social policy interventions per factor relate? 6. What are the most influencing factors of BGP in SADC? 7. What social repercussions are caused by socio-technical environment? 8. How can the social repercussions and Socio-Technical environment attributes be addressed?

As explained in Chapter 3 section 3.2.1.5, the research approach used in this research is mixed methods with concurrent strategies since both quantitative and qualitative data was gathered and analysed at the same time independently.

4.3: Sample distribution

The first part of the analysis is the distribution of participants by SADC member states. The graph 4.1 below show who sample was distributed by countries.

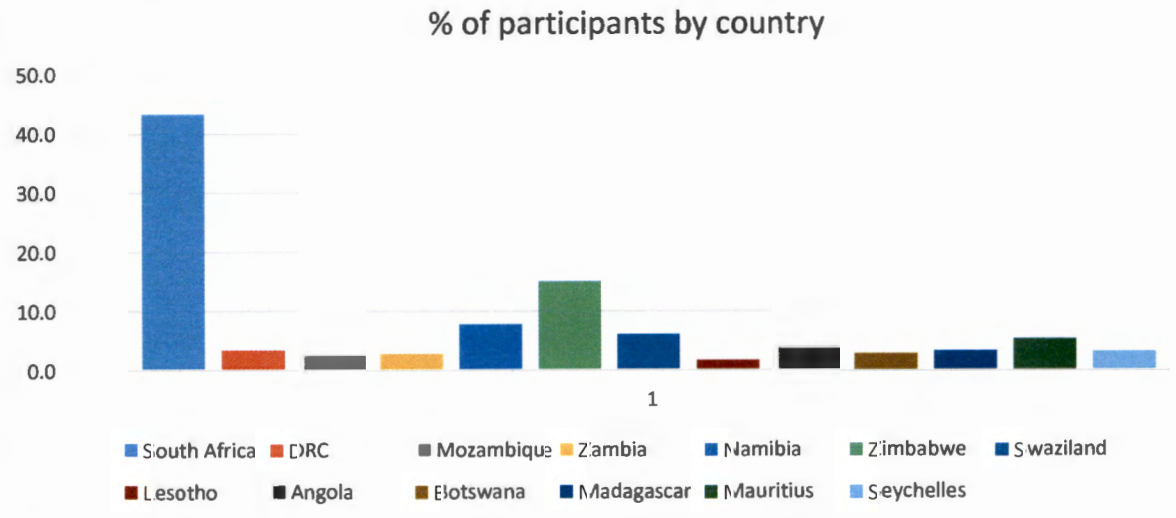


Fig 4.1: Percentage of participants by country

The above graph indicates the distribution of participants by countries in SADC. Though this analysis is not part of the objectives but it serves to validate generalisability of the results within the region. Presently, SADC has 15 member states. This research managed to gather data from 13 of these and this accounts for about 87% of the SADC countries. This high participation of member states justifies generalisation of the results. Complete raw data of the above graphs is found in Appendix 1. Table 4.0 below illustrates how the survey questions were answered in frequency of responses per question.

Table 4.0: Frequency of responses per question

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Frequency	552	547	543	545	549	542	545	546	537	542	541	552	537	522	519	458	390	371	378	337	330

The following section discusses objectives 1 to 3 with special attention to objective 3, the confirmatory factor analysis.

4.4: Confirmatory Factor Analysis (CFA) using AMOS.

This research used a moment structures (AMOS), a statistical software to perform CFA. . AMOS is an added SPSS module, and is specially used for Structural Equation Modelling, path analysis, and confirmatory factor analysis. It is also known as analysis of covariance or causal modelling software with the primary goal of understanding the shared variance of measured variables that are understood to be attributable to specific latent variable or unobserved constructs. It is therefore, appropriate to say CFA is to test whether measures of a construct from gathered data are consistent with the researcher's prior knowledge of the nature of the construct in question. To this effect this CFA was used to test a prior hypothesis of factors that influence broadband growth and penetration as guided but Socio-Technical Systems Theory. In this part of analysis, 385 participants were need by calculation. The researcher targeted 500 participants and the actual number of participants turned out to be 550.

Objective one and two were addressed from literature as the underlying factors of BGP were established using STST in chapter 2 of this research. The subsystems of the Socio-technical Theory were considered as the underlying variables or latent factors in this research. In order to confirm

these factors, they had to be validated by observed variables as obtained from participants in SADC countries.

The following measurement model was developed and tested for fit. Several divergent opinions exist about how to evaluate fitness of model but Kline (2010) recommends that the following indices be reported on; Chi-squared test, the RMSEA, the CFI, and the SRMR. This analysis will focus on the first three of these and the GFI, however all other indices of interest can be found in Appendix 2 through 6.

According to Schermelleh-Engel and others (2003), a model can have a good fit but that does not mean that it is correct. A good fit model can only be regarded as plausible. In the following model no constraints were used and four iterations of modifications were done to better the fit.

Correlation between latent variables serve to show the distinction between these variables and this can be achieved by using the promax method with the lowest kappa value giving the maximally distinguishable underlying constructs (Matsunagu 2010). These methods are set within SPSS. In this analysis, these correlations were not considered for the following reasons: The correlation values would be close to one, suggesting that there is little or no difference at all between the latent variables. That would be undesirable in the model at face value. However, such high correlations should be expected in this particular model because according to STST, the theory that establishes these variables, the variables are so related that that they exist in an ecosystem (Kelly 2010). For example, Environment and Technology are justifiably subsets of or inherit from Society. That is how the concept of correlations between latent variables in this model falls short.

The following analysis starts with an unmodified measurement model, highlighting the four indices of interest namely the Chi-square, RMSEA, CFI and GFI.

4.1: Analysis of the unmodified model

Table 4.1: CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	40	**459.618**	131	.000	3.509
Saturated model	171	.000	0		
Independence model	18	3353.570	153	.000	21.919

CMIN is the minimum value of the discrepancy between the model and the data. This is the same as the chi-square value. It therefore, holds to say chi-square value measures the difference between the measured or observed and the expected covariance matrices. Values of chi-square closer to zero indicate a better fit (Gatignon 2010). Therefore the smaller the chi-square value the better the model.

The chi-square value in this first model is very high. Measuring model fit only by chi-square value can cause problems because with big data sample chi-square value tends to go up and yet the model becomes plausible mostly with big data samples (Gatignon 2010). Therefore, other indices of fit are necessary to be considered.

Table 4.2 shows the comparative fit index. Comparative fit index (CFI) analyses model fit by examining the disparities between observed data and a prior data but taking into consideration the question of sample size which affect the chi-square value as discussed above

Table 4.2: Baseline Comparisons- CFI

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.863	.840	.898	.880	**.897**
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

CFI value should be between 0 and 1, with 1 being the best fit. The cut-off point 0.9. This unmodified model is obviously not acceptable given that CFI value is less than 0.9. This means that the model is not the best fit model yet and needs to be adjusted especially by regrouping the indicators into correct latent variables.

Table 4.3 below shows another constant of interest in this analysis, the root mean square error of approximation (RMSEA). This circumvents the issue of sample size by considering the

discrepancy between a prior model, with optimally chosen parameter estimates, and the sample covariance matrix, that is according to Hooper and others (2008).

Table 4.3: RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	**.068**	.061	.074	.000
Independence model	.195	.189	.201	.000

The RMSEA ranges from 0 to 1, with smaller values indicating better model fit. A value of .06 or less is indicative of acceptable model fit. Clearly the RMSEA shown in this model is more than 0.6 and so falls outside the range of acceptable value.

Table 4.4 shows the goodness of fit index. The goodness of fit index (GFI) measures the fit between the hypothesised model and the observed covariance matrix. The adjusted goodness of fit index (AGFI) corrects the GFI, which is affected by the number of indicators of each latent variable.

Table 4.4: GFI

Model	RMR	GFI	AGFI	PGFI
Default model	.535	**.911**	.884	.698
Saturated model	.000	1.000		
Independence model	3.660	.335	.256	.299

GFI values range between 0 and 1 where 1 is a perfect fit. The cut-off value of 0.9. Even though the GFI in this model is good enough but the model has failed in all other areas as shown above.

For that reason, a second iteration was run to better the model fit. Modifications had to be dome first by drawing covariance arrows between indicators or observed variables with highest errors

but loading onto the same latent variables. This had to be done one pair of indicators at a time, only taking ones with highest errors.

The following tables of indices refer to the fourth and last iteration showing the best fit possible with this analysis. Modifications of the first, second and third iterations are shown in the appendix 3 through 5.

4.4.2 Analysis of the best fit model

This section begins with the actual measurement model, with keen interest in values of the factor loadings. Many researchers agree on cut- off value of 0.4 on factor loadings, with any indicators of less than 0.4 discarded.

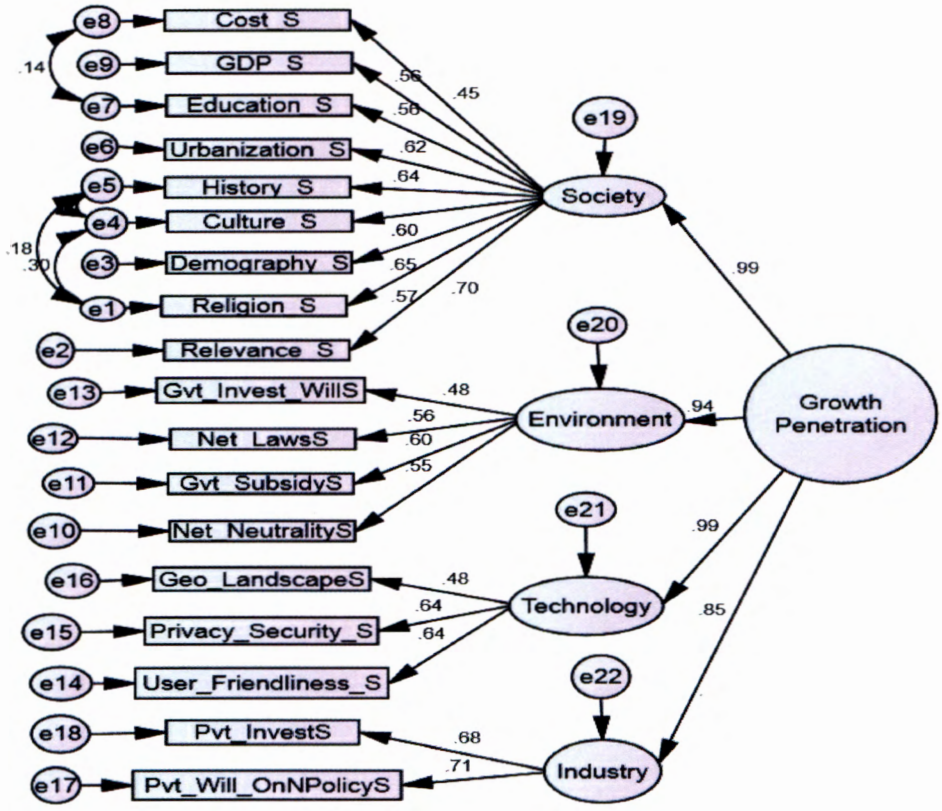


Fig. 4.2: Measurement model of BGP factors

As can be observed above, none of the factor loadings are below .4. This validates all the BGP factors as suggested by literature. The following tables of indices analyses the fit of this last model.

Table 4.5: CMIN/ CHI-SQUARE Value

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	44	**330.026**	127	.000	2.599
Saturated model	171	.000	0		
Independence model	18	3353.570	153	.000	21.919

The chi-square value has reduced significantly through the four modifications done. This last value of chi-square owes its size to a large sample used and is vindicated by other indices of fit as seen below.

Table 4.6: Baseline Comparisons- CFI

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.902	.881	.937	.924	**.937**
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

CFI value of one denotes the best fit. The cut-off point is 0.9. In this model the CFI obtained is well within acceptable range.

Table 4.7: RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	**.054**	.047	.061	.175
Independence model	.195	.189	.201	.000

For an acceptable fit the values of RMSEA should be below 0.6. The smaller the error the better the model is. This condition is satisfied in this model.

Table 4.8: GFI

Model	RMR	GFI	AGFI	PGFI
Default model	.435	**.935**	.912	.694
Saturated model	.000	1.000		
Independence model	3.660	.335	.256	.299

The GFI value, though it was still acceptable in the unmodified model has improved significantly in this final model making it better. The cut-off point is 0.9 with 1 being the best fit.

As explained in section 3.3.1 under measurement validity, Table 4.9 below gives CR and AVE for of the variables in the measurement model. By entering the factor loadings for each latent variable into an online CR and AVE calculator, their values were automatically calculated.

Table 4.9: Construct validity of CFA measurement model

Construct	**CR**	**AVE**
Society	0.80	0.4
Environment	0.63	0.3
Technology	0.61	0.4
Industry	0.65	0.5
Growth-Penetration	0.97	0.9

According to Fornell and Larcker (1981) all the indices of CR are acceptable because they are either above 0.6 cut-off point for CR. However, the first three of the AVE are below the cut-off point 0.5 for AVE. This discrepancy could be emanating from the fact that the first order latent variables are highly correlated and yet the researcher could not collapse into common variable because they are informed by the standard theory (STST) that was used in this research.

Given that the factors that affect broadband growth and penetration in SADC have been identified and confirmed quantitatively, the next step in the analysis is to identify the interventions needed to address these factors and their appropriateness of application analysed.

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4.5: Interventions and their ratios

This section of analysis answers objectives 4 and 5. The purpose of this analysis is to highlight policy as the solution to the question of broadband growth and penetration in SADC. Using policy as a tool to address both business and social challenges is widely accepted in literature as shown in chapter 2 of this research and validated by participants as no other type of intervention was suggested.

In answering the question of which policies would be suitable per given factor or group of factors the question was posed to participants:

"Research has shown that in order to address each of the given factors above, intervention in form of social and business polices is necessary. In your opinion, for each of the factors identified in question 5 above, which type of policies do you think are needed more, social or business? Choose from the following ratios of social to business policies. (1:2 means that for every one social policy we need two business policies and 2:1 means that for every two social policies we need one business policy)"

The responses given are summarized in the table 4.9 below:

Table 4.9 Policy ratios per BB Growth Factor

Answer Options	1:3	3:1	1:2	2:1	1:1	Other ratio	Response Count
Willingness by government to invest in Information and Communications Technology (ICT).	81	111	**126**	112	58	6	494
Geographical landscape of the area in need of internet.	45	99	**121**	118	54	13	450
Private investment in ICT.	40	67	**131**	81	56	6	381
Internet laws at play in a given country.	31	70	**108**	102	79	15	405
Government subsidies in private ICT companies.	34	71	**128**	88	69	10	400
Willingness of private ICT companies to uphold national agendas.	37	82	**123**	99	68	12	421
Net neutrality (equal access to the internet by all service providers).	48	101	**76**	87	92	18	422
Other.	17	12	**32**	20	26	11	118
					answered question		**541**
					skipped question		**10**

From Table 4.9 the following can be noted: columns 1 and 3 favour business policies over social policies. Columns 2 and 4 favour social policies over business policies. Adding participants in each of the pairs will indicate which type of policy should be predominant for each factor. Overall, it can be noted that except for net neutrality, all of these BB growth factors require business policies at an average ration of two business policy for every social policy in order to be addressed. The research can therefore conclude that business policies should be predominant in order to promote broadband growth in SADC. The same analysis can be done for broadband penetration factors. The following BB penetration result are analysed in the same way.

In response to the question "Research has shown that in order to address each of the given factors above, intervention in form of social and business polices is necessary. In your opinion, for each factor identified in question 8 above, which type of policies do you think are needed more, social or business? Choose from the following ratios of social to business policies. (1:2 means that for every one social policy we need two business policies and 2:1 means that for every two social policies we need one business policy)", results in Table 4.10 were obtained.

Table 4.10: Policy ratio per BB Penetration Factor

Answer Options	3:1	1:3	2:1	1:2	1:1	Other ratio	Response Count
Gross Domestic Product (GDP) Per Capita of a country.	86	100	**101**	75	52	9	423
Cost of using the internet.	71	76	**144**	90	63	14	458
Level of education of the people expected to be using the internet.	83	72	**124**	100	59	10	448
Urbanization of the society.	57	54	**109**	113	58	15	406
History of the people expected to be using the internet.	47	45	**120**	79	75	12	378
Culture of the people expected to be using the internet.	52	61	**98**	82	81	14	388
Demography of the internet users.	50	60	**120**	92	64	11	397
Privacy and security concerns of using the internet.	37	88	**91**	112	61	14	403
Relevance of services and content found on internet.	46	69	**107**	94	62	9	387
User friendliness of the internet.	59	71	**98**	96	70	19	413
Religious beliefs.	44	45	**84**	63	84	23	343
Other.	13	16	**28**	21	16	14	108
Other (please specify)							3
						answered question	**536**
						skipped question	**15**

Taking the same approach as for BB growth factors it can noted that from the table above more social policies are needed to promote broadband penetration in SADC as the first and third columns add to more preferences than do second and fourth columns. The predominant ration for these factors is two social policies for every one business policy save for the highlighted factors. It is indeed arguable that the three heighted penetration factors can be addressed by business policies

predominantly. However it is also important to note that the difference in numbers for these three factors is marginal, almost negligible.

From the above results the research can conclude that to increase broadband penetration in SADC more social policies are needed an average ration of two social policies for every business policy.

When both categories of factors are put together and ranked in the order of their influence, the following graph resulted.

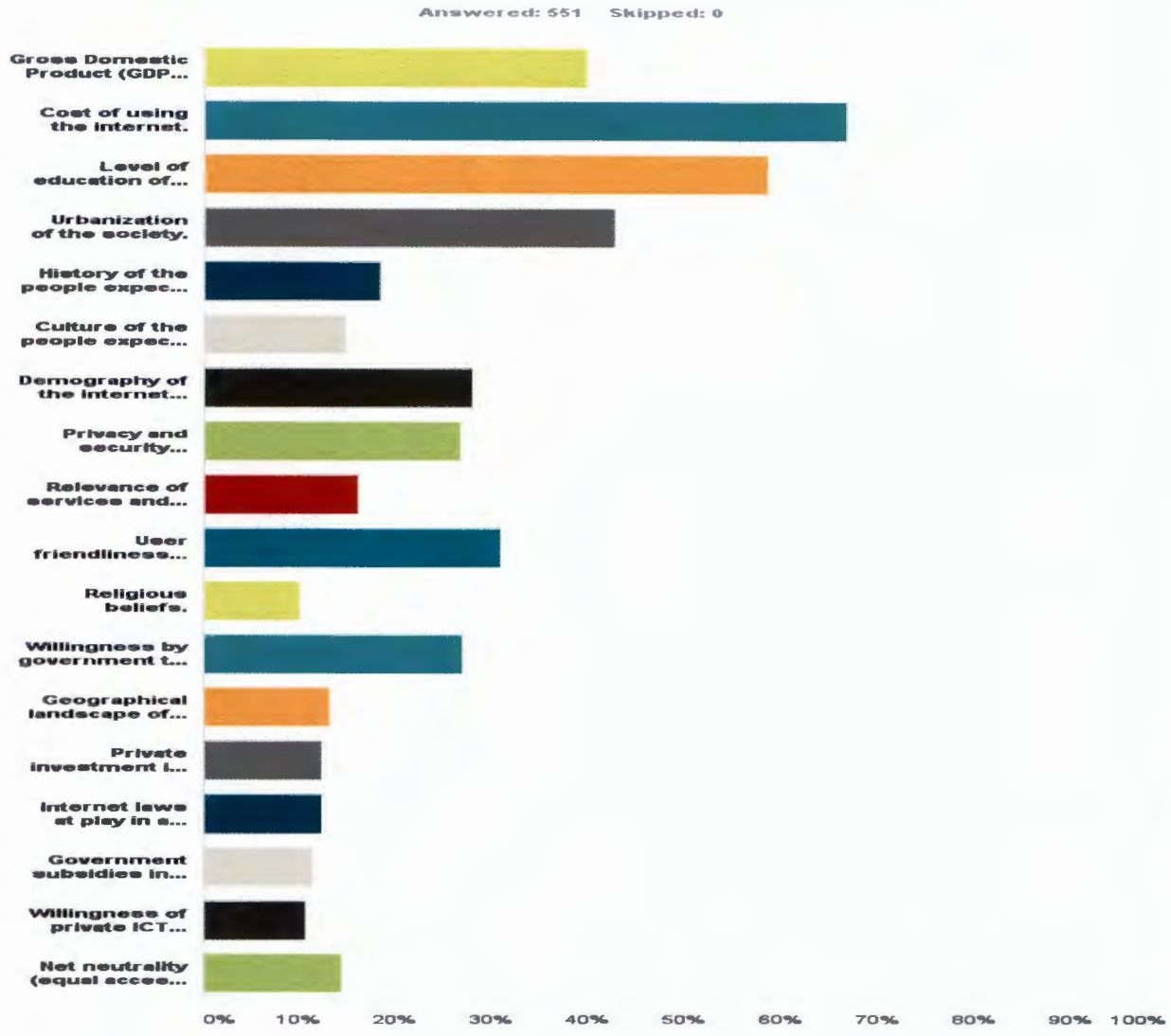

Fig 4.3: Factor ranking

It is notable that the first four most determining factors of BGP are all social factors. Cost of using the Internet and level of education are the two most influential factors of BGP.

This ranking analysis was also done for both sets of factors separately and the results are in appendix 10 and 11.

In the foregoing section of the analysis the research has dealt with the quantitative part of the data gathered. In line with the mixed methods research approach adopted by this research, the following section is dedicated to the qualitative data analysis.

4.6: Qualitative data analysis using Atlas.ti

The last two objectives of this research, namely identifying the attributes and social repercussions of a socio-technical environment and the policies needed to address these. In answering these two objectives both open ended survey questions asked and in-depth interviews were conducted. Five experts were interviewed and more than 450 people answered the qualitative questions online. The interviewed experts are from selected SADC countries. The researcher had to travel to these countries to meet with the experts. Both of these sets of questions were analysed using Atlas.ti. The project in Atlas.ti was saved as a bundle and can viewed from its environment. Further to analysing survey qualitative responses using Atlas.ti, a Survey Monkey Text Analysis tool was used to further analyse the online survey qualitative responses in order to increase integrity and robustness of the results.

The summary of qualitative results as analysed using Atlas.ti can be seen from the network diagram shown below. A better view of this diagram can be seen from the Atlas.ti environment itself. What is observable from the network diagram is that the socio-technical environment is associated with three major scenarios. These are the attributes inherently present in the socio-technical environment, the repercussions or the negative effects of a socio-technical environment and the policies that need to be implemented in order to address both the attributes and the repercussions. These three elements are then further unveiled according to data.

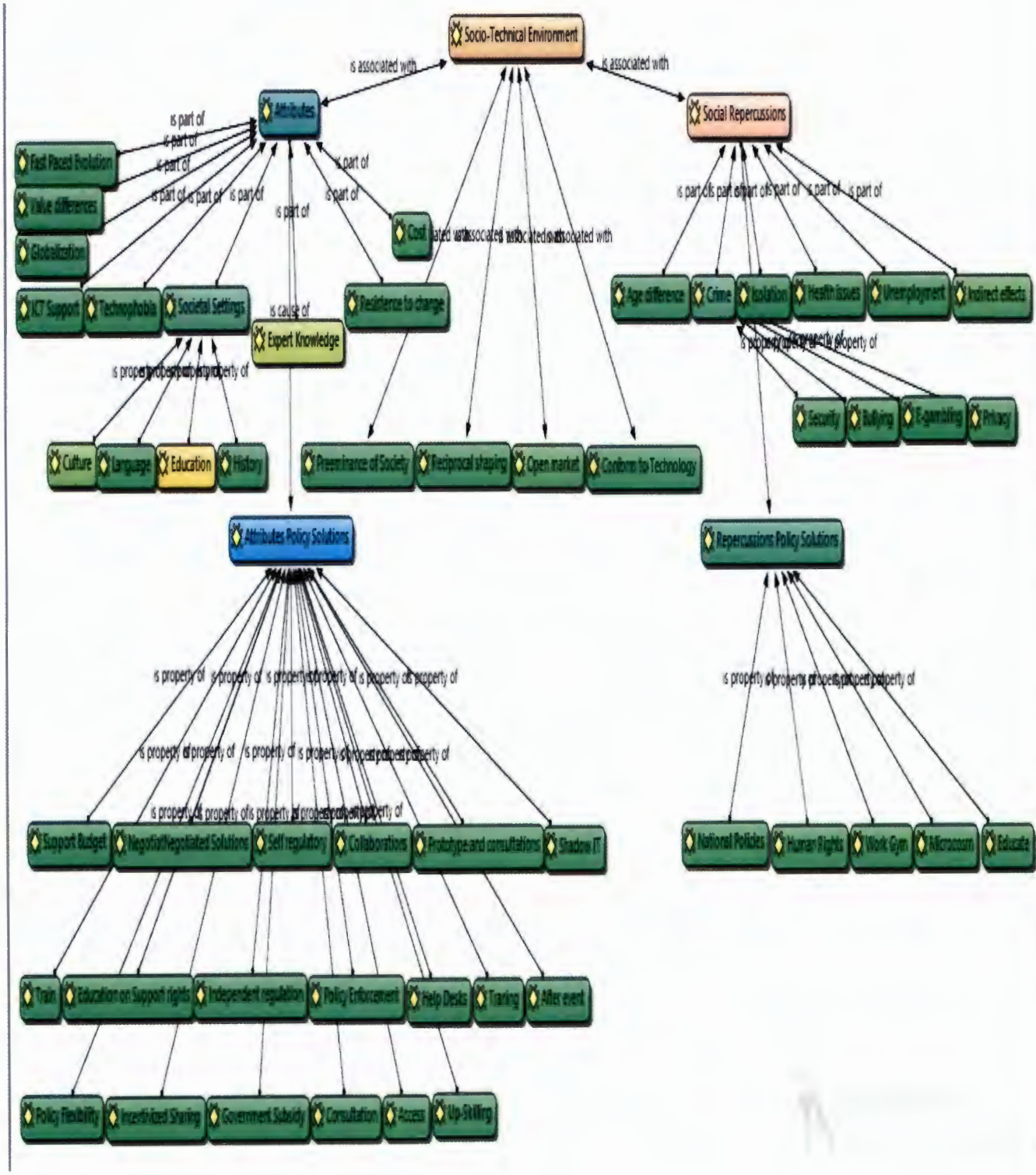

Fig 4.4: Qualitative Analysis Network

The colour density of the nodes in the diagram speak to the groundedness of the node. More grounded nodes are those based on much data evidence. These are a few node which are free from any data and there were created to give context to the diagram. In the actual environment, right clicking on a node would give all the quotations from the primary documents that are connected to that code or node.

Before discussing these results and drawing any conclusions from them the researcher looked at another set of results of qualitative online questions that were analysed using Survey Monkey Text Analysis tool.

4.7: Qualitative data analysis of online responses using Survey Monkey Text Analysis Tool

The tool highlights distinguishing words rather than common words, therefore word frequency is not the primary factor. For an example 100 people may say, "I like..." The important word would be what follows rather than showing the phrase "I like" as important or unique (Survey Monkey 2016). This tool also shows the percentage of appearance of the distinguished words or phrases. The usefulness of this tool is that it helps to establish themes where hundreds of participants are involved in an online qualitative survey. The main weakness of this tool is that it can just give significant single words without context and the researcher would have to go back to the quotations to seek context and if possible rephrase to give meaning.

The following pie charts were constructed following a question by question online responses. The first qualitative was question was question 16 of the survey:

In your own words what do you suggest that governments should do in order to improve usage of internet by citizens?

The main aim of this question was to extract possible policies that can be implemented by authorities in order improve usage ICT by the general public. The availability of ICT infrastructure does not necessarily imply that citizen are using these facilities. Therefore, policies need to be in place that promote penetration of broadband, that increasing the number of users that actually broadband. In response to these question the most significant phrases that the respondents used by their percentages are shown in chart 1 below.

The phrases indicated by the chart were not the most frequently used phrases but rather the most significant ones. They carry the most popular response to the question posed. These responses were integrated with responses expert's in-depth interviews on similar questions to give a consolidated theme which is more accurate than relying on just one set of responses.

The following chart 4.1 shows the possible themes for consideration in making policies aimed at increasing broadband usage or penetration in SADC.

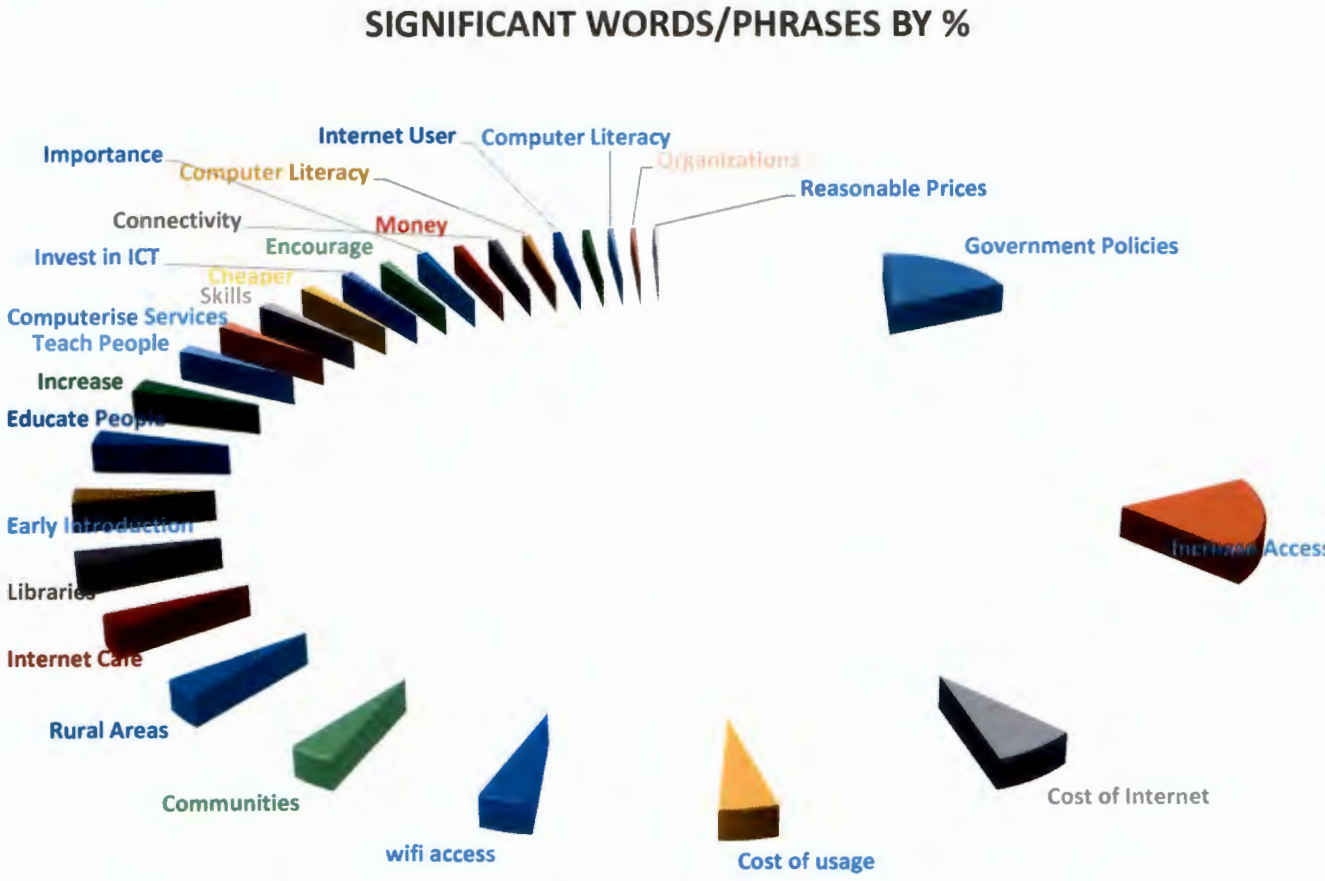

Chart 4.1: Measures to improve Internet usage

The phrases that were used in the chart 4.1 were mostly presented by the researcher as they appeared in the raw data. Therefore, some phrases may refer to the same thing. As can be seen in

the results, 36% of the respondents highlighted political will and increased access as major measures to increase penetration of broadband. This is given by 18% for "government policies" and "access" a piece. Other measures can be summarised as education and training, cost, investment, infrastructure and urbanization.

Question 17 was aimed at identifying social repercussions that are caused by broadband penetration. Chart 2 with give the most significant phrases in answering this question:

Digitization and computerisation of services has social repercussion among workers and customers. Which are some of this repercussions in your opinion? This question's responses were integrated with responses from experts to reach a more robust conclusion in answering the objective of social repercussions as part of the proposed framework.

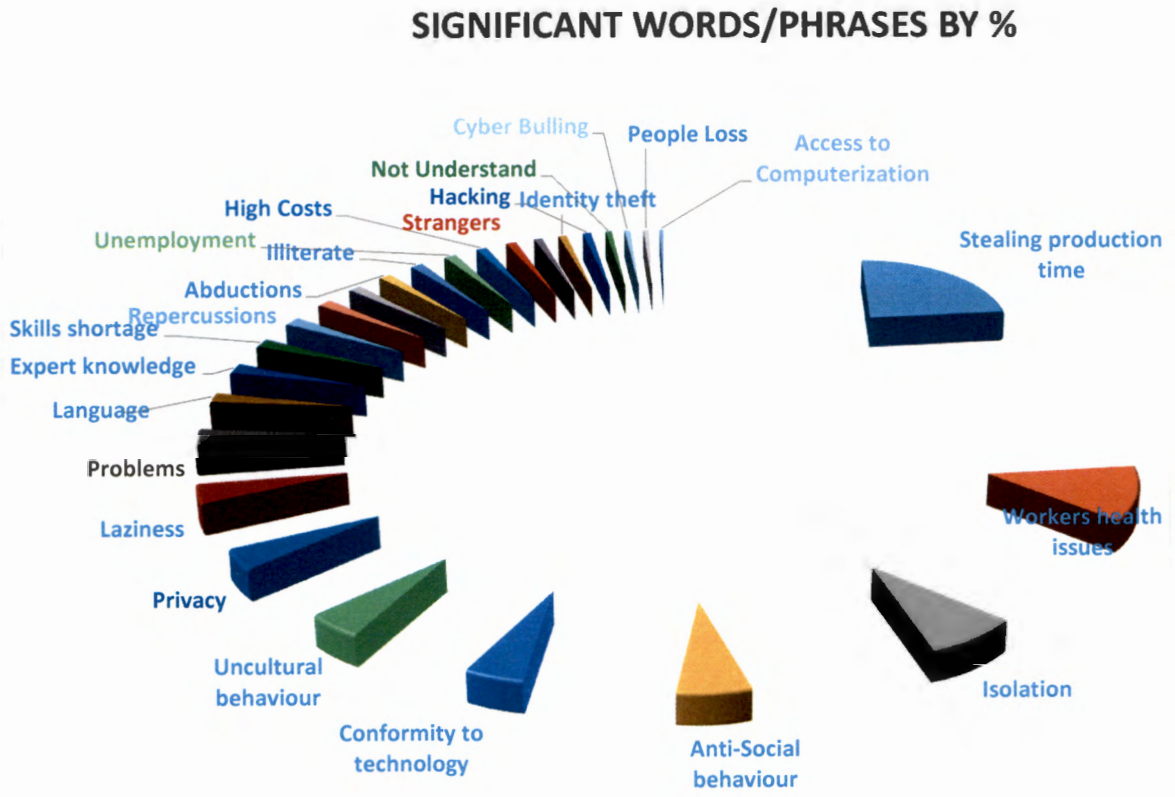

Chart 4.2: Social Repercussions of a Socio-Technical Environment

These results speak to the objective; "to identify social repercussions that are caused by socio-technical environment." It was necessary that before any policy suggestions can done to address the negative effects of using broadband that such negative effects be identified first and the above chart 4.2 highlights those effects in SADC.

After identifying these social ills caused by the use broadband then chart 3 below gives the policies implementable to mitigate against these ills. The following chart, aims at point out policy themes that can be considered by authorities to curb the repercussions of broadband uptake.

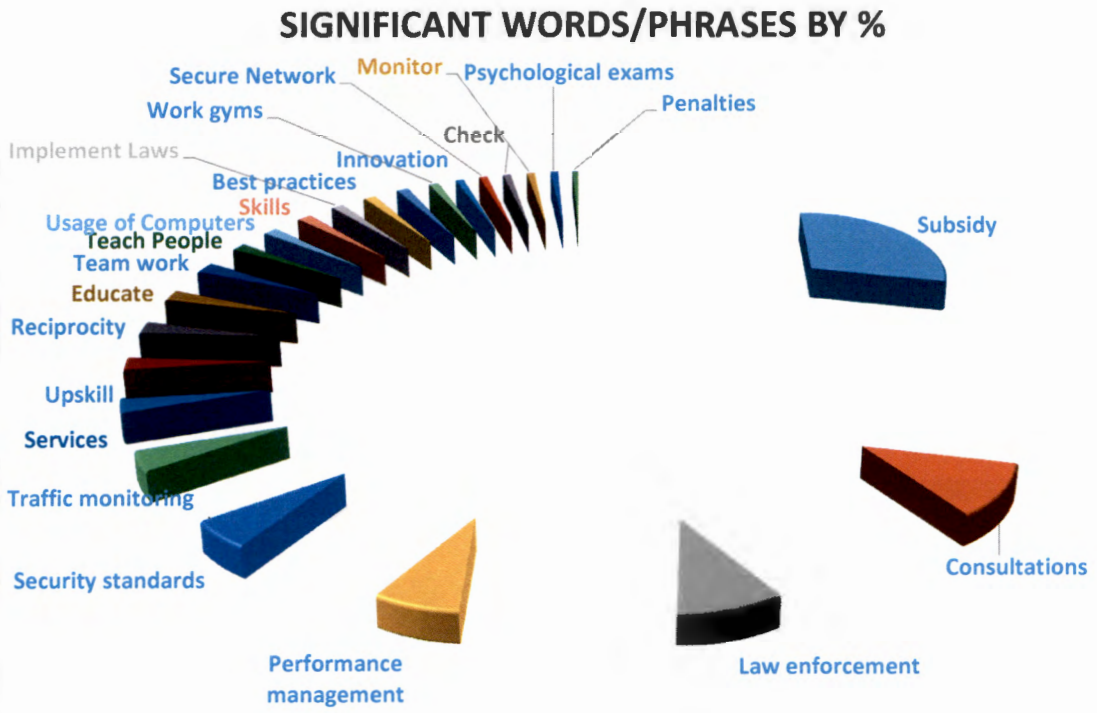

Chart 4.3: Policies to address social repercussions

These results speak to the policy interventions that governments and organisation need to implement in SADC in order to reduce social ills that come as a result of using broadband. The

chart 3 above was integrated with the repercussion section of the Atlas.ti network diagram to draw final conclusions.

One striking repercussion of a socio-technical environment is that of conformity. It's either society is expected to adjust to take advantages of technological advancements or technologies are crafted in line with values and belief systems of society. The following chart 4.4 gives suggestions by SADC on how it has to be. These suggestions should form the basis for policy formulations that should address the repercussion of conformity. Below is chart 4.4

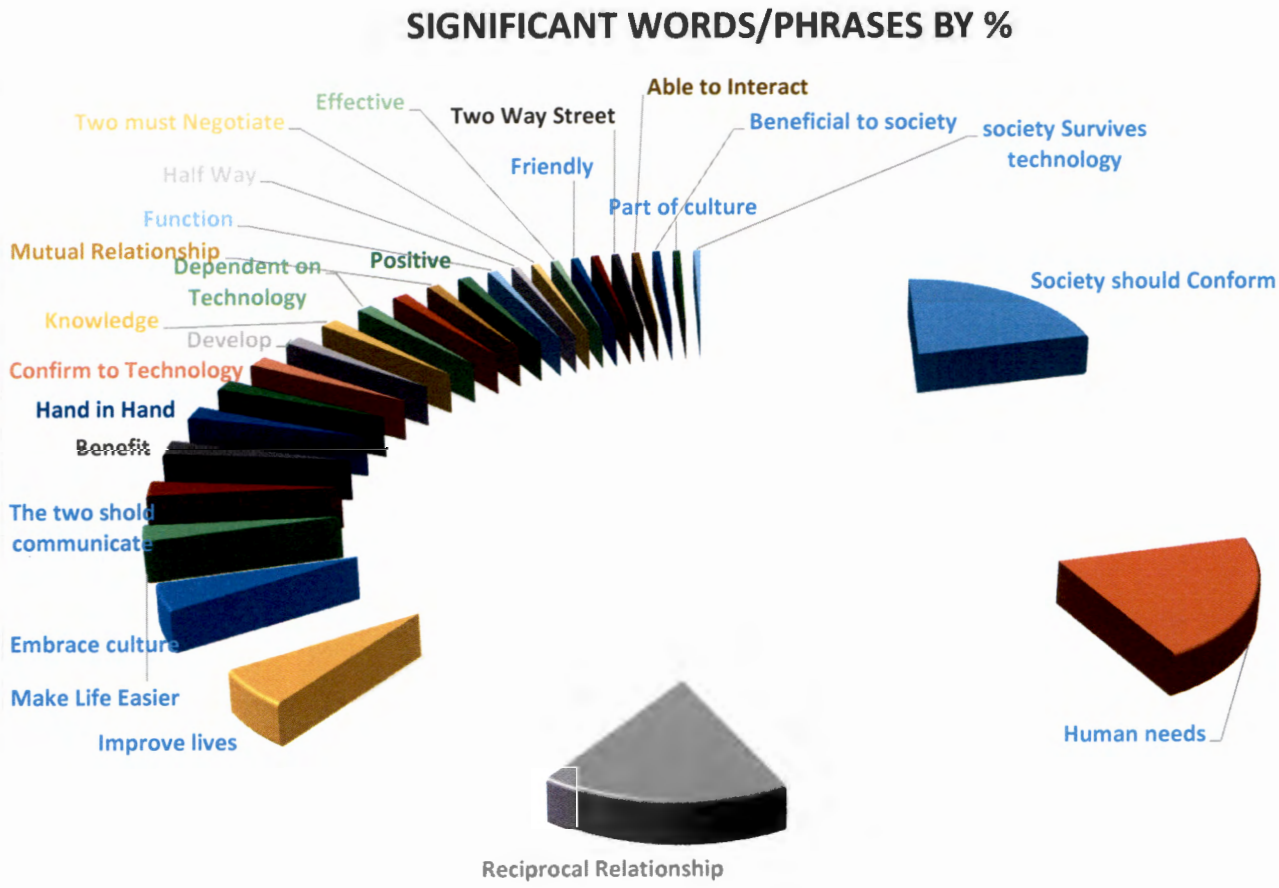

Chart 4.4: Society-Technology Relationship

In the convention business model broadband technological development is thought in terms of an array of state of the art equipment and devices that people or workers of an organisation should take advantage of to improve production or delivery of service. This invariably took no account of the values of the people involved nor the uniqueness of the society in which the technology is being deployed. As can be seen from chart 4.4, human needs are taking the center stage as the driver for technological development. Reciprocal shaping of the two comes second and fewer gave precedence to technology. This research therefore, suggests from gathered data that culture of a people and their unique needs should determine how technology should be used among them. Before presenting the interpretation of these results, the following section discusses the principles of interpreting qualitative data that the researcher used in this work.

4.8: Principles for interpreting qualitative research findings

There are seven principles of interpretive field research according to IS literature. The first was by Klein and Myers, the fundamental principle of hermeneutic circle (1999). This is an anchoring principle used in interpretive research and all other six principles are derived from it. The other six principles depend on each other and these can be applied in IS research when the researcher(s) want to determine relevant context(s) that should be explored (principle two) which in turn depends upon the following: how the researcher "creates data" in interaction with the participants (principle three); the theoretical premise or concepts for abstracting and generalising (principle four); the researcher's intellectual foundations (principle five); varying versions of the narratives unveiled by the research (principle six); and the aspects of responses the researcher critiques (principle seven). Methodology, the principles presented in Table 4.11 "demonstrate that the interpretive research does not set out to test hypotheses, does not predefine dependent or independent variables, but aims to give an understanding of the social context of the phenomenon and the process whereby the phenomenon influences and is influenced by the social context" (Walsham, 1995).

Table 4.11: Summary of principles for interpretive field research

1	**The fundamental principle of the hermeneutic circle** This principle suggests that all human understanding is achieved by iteration between the interdependent meaning of parts and the whole they form. This principle of human understanding is fundamental to all the other principles.
2	**The principle of contextualization** Requires critical reflection on the social and historical background of the research setting, so that the intended audience can see how the current situation under investigation emerged.
3	**The principle of interaction between the researchers and the subjects** Requires a critical reflection on how the research materials (or "data") were socially constructed through the interaction between the researchers and the participants.
4	**The principle of abstraction and generalisation** Requires relating the idiographic detail revealed by the data interpretation through the application of principles one and two to the theoretical general concepts that describe the nature of human understanding and social action
5	**The principle of dialogical reasoning** Requires sensitivity to possible contradictions between the theoretical preconceptions guiding the research design and actual findings ("the story which the data tells") with subsequent cycles of revision.
6	**The principle of multiple interpretations** Requires sensitivity to possible differences in interpretations among the participants as are typically expressed in multiple narratives or stories of the sequence of events under study. They are similar to multiple witness account, even if all tell it as they saw it.
7	**The principle of suspicion** Requires sensitivity to possible "biases" and systematic "distortions" in the narratives collected from the participants.

(Adopted from Klein & Meyers 1999)

The following sections explain how each of the principles in Table 4.11 were applied to this research during interviews with participants.

4.8.1: The fundamental principle of the hermeneutic

The hermeneutic circle delineates the collaboration between the entire and its parts. It focusses on the steady development between the individual parts and the whole. The whole comprises of the mutual implications from the associations between the researcher and the participants comprehension of the issue at hand. The parts are the individual comprehension of the researcher and the participants' of the issue under investigation. During the interviews the researcher conscious tried to integrate his understanding to that of the participants of the same phenomena.

4.8.2: The principle of contextualization

Contextualisation is the way of understanding the verifiable connection of the present of a situation with its past. The motivation behind why the interpretive researcher thinks about the setting contrasts from the positivistic quest for rehashing designs, since the interpretivist understands that the organisation, industry or nation evolves. A reliable comprehension of the present circumstance is accomplished by considering the road that was taken by the organisation to achieve the present state. The verifiable setting must be reflected in the results of the research.

During the interviews the researcher travelled to countries of the participants to familiarise with settings and the contexts of the participants. All responses were considered in the contexts of the countries of participants. Other experts however had global knowledge of the whole SADC region and that assisted the researcher correlating phenomena in various countries

4.8.3: The principle of interaction between the researchers and the subjects

Data is generated as an aftereffect of the social collaboration between the participants and the researcher. The participants are, just as the researcher, interpreting the occasions they represent. The analyst ought to know about this and remunerate by utilising optional sources, for instance recorded documentation, to confirm the interpretation of particular ideas. The researcher ought to know about the way that the connection between himself/herself and the member may change the interpretation of the participant. The researcher may, just by asking a particular question, alter the participant's impression of the subject under scrutiny. The researcher tried to maintain neutral connection with the participants by avoiding undue detractions from the subject of investigation

4.8.4: The principle of abstraction and generalisation

According to Klein and Myers (1999), this requires the interpretivist interpret the data through the application of theories. This means that data is interpreted through application theories that explain human understanding and social behaviour.

Walsham (1995) identifies four types of generalisation in interpretive research which are: concepts development, theory generation and the unearthing of specific latent implications "and the contribution of rich insights". This research generates theory in form of framework, unveils specific implications of the framework and contributes rich insights. The primary outcome of multiple case studies were the foundations of early theory building efforts (Miskon 2013). In this research the researcher was an outside observer with the advantage of reducing bias and of not be present in the environment and setting of the participants. The theoretical lens through which this research was conducted and interpreted is the socio-technical systems theory.

4.8.5: The principle of dialogical reasoning

This principles requires the researcher be prepared to question and critique his/her own original theoretical dispositions including the original research design. Revising these in line with the obtained results and if necessary changing them. This also includes the philosophical underpinnings of the research being questioned. The principle makes it necessary for the researcher to have proper dominion on the research design used and be able to interpret data in line with it.

4.8.6: The principle of multiple interpretations

The researcher interviewed different participants of the same countries. As such, sensitivity was needed to different accounts of the same story. This requires the researcher to analyse beneath the surface to resolve the contradictions. Multiple interpretations were evident in this research also as different participants from different countries gave different interpretations to common regional phenomena. The researcher had to take this into account to produce a concise position from all different voices.

4.8.7: The principle of suspicion

According to Miskon, Bandara and Fielt (2015), this includes not taking the respondent's view at face value, and always triangulating and further probing of evidence from the same source, a comparison information from respondents on the same question, and an application of contextual background.

Distortions in the data can be due to power struggles within an organisation, a nation or a region. Psychopathological delusions, economic structures and political strife can also be a causes of distortion and the researcher exposed these. In this research responses from different participants were compare for consistency and suspicious were treated differently.

Section 4.9 expounds on the results or findings on one hand and interpretation of these on the other in the categories of socio-technical environment attributes, social repercussions and suggested policy interventions for each of these.

4.9: Results and interpretation

The following section consolidates the two batches of analysed results which are from Atlas.ti and Survey Monkey Text Analysis tool. Together with these results are some select quotations from the primary documents to augment the interpretations reached. The interpretation of these results is presented in this section as answers to the research questions; what policies are needed to address the attributes of a Socio-Technical environment and what social repercussions are caused by broadband growth and penetration and how can they be addressed?

4.9.1: Inherent attributes of a socio-technical environment

Salient themes of attributes of a socio-technical environment that researcher obtained from experts in the field and analysed using Atlas.ti are the following: fast paced evolution, resistance to change, paucity of expert knowledge, cost, technophobia, ITC support, social settings, globalisation. This question of attributes of the socio-technical environment was answered exclusively by experts and the above themes represent some of their knowledge on the subject matter. These results are illustrated as part of Fig 4.4. Table 4.12 below zooms in on these results. On this diagram we focus

only on the arrows directly linked with the node "attributes". From the primary documents, the following quotations support some of these attributes:

"Collaborations, mentorship programs, team work. These are policies implementable to preserve expert knowledge".

In the above quotation, even though the expert was answering the question on how to preserve expert knowledge he was at the same time ascertaining the fact that expert knowledge is inherently present in a socio-technical environment and needs to be harnessed.

"Consult first to establish context"

In the above quotation, the expert discloses that social contexts and settings are existent in a socio-technical environment. Therefore these form part of the attributes of the environment.

"The cost of broadband infrastructure also determines tariffs. Multi players' policy can be a solution."

In the above statement the thrust of the expert's response was that of multiple players as a solution to lowering cost by market forces yet at the same time he was acknowledging cost as an attribute of the environment. Similarly, all other attributes could be derived from the expert's answers to other question

Therefore, the question of attributes was not asked directly nor was it answered directly but most of the attributes were implied in answers to other questions. This was done to in order to maximize on time and harness as much as possible from the experts. Table 4.12 below shows the attributes that the researcher could get from experts

Table 4.12: Socio-technical Environment Attributes

Attributes	Fast paced evolution	Globalization	Technophobia	Expert Knowledge	Complex contexts	Value differences	Social-ICT support	Resistance to change	Cost	Negotiated and multivalent relationships

In table 4.12 above the attribute shown were extracted from Fig 4.4, the network diagram for qualitative analysis. These are by no way exhaustive but they cover essential group of attributes as corroborated by literature.

The interpretation the researchers makes of these findings is evident. From the results one can say that there are attributes that are associated with a socio-technical environment as shown in Table 4.12. These attributes constitute themes that need to be provided for in a socio-technical environment. These themes and sub-themes when exposed in a framework for broadband growth and penetration give the basis for formulation of policies that provide a conducive environment for business and social life.

It is interesting to note that the identified attributes of a socio-technical environment are inevitably present in any society. In some societies they manifest to a lesser extent than in others. It therefore, becomes necessary to have police in place that enhances the positive attributes and curb the effects of the negative ones. Section 4.9.2 that's following addresses the question of policies that need to be put in place in order address the attributes mentioned in section 4.6.1 above.

4.9.2: Policies that address attributes of a socio-technical environment.

Attributes of socio-technical environment are naturally not necessarily negative. These are characteristics that are native to such an environment. However, these attributes do not manifest the same way in different societies. An example would be that technophobia may not manifest the same way in developed nations as it would in developing ones due to historic differences in exposure and access to technology. Knowing these attributes better informs organisations on what policies can be put in place to either enforce the attributes or minimise their effects on business and society. Attributes like fast paced evolution can be a positive one if it promotes innovation and betterment of quality of life. However coat as an attribute may need ways to reduce it if it's high. It is on this background that the question of policies for attributes was asked in interviews and survey.

Two sets of responses were collected; one from experts and the other form non experts through online survey with about 550 respondents. The two sets were analysed jointly to give a richer perspective on how to addressing the attributes. Table 4.13 below gives some policy themes that can be used to address the attributes of socio-technical environment.

Table 4.13: Policy solutions of attributes

Attributes	Fast paced evolution	Globalization	Technophobia	Expert Knowledge	Complex contexts	Value differences	Social-ICT support	Resistance to change	Cost	Negotiated and multivalent relationships
Policies	Prototyping and consulting	Access	Upskilling	Collaborations	consultation	Education	Support rights education	Education	Market forces	Consultation
	Shadow IT	Policy flexibility	Education	Incentivized Sharing of expertise	Training	consultation	Support budget	Early introduction to ICT	Government subsidy	Negotiated solutions
	Negotiated solutions	Policy flexibility	Help desk		Self - regulation	collaborations		Policy enforcement	Policy enforcement	Prototyping and consultation
	Collaborations	Self - regulation	Access	After effect	After effect	After effect	After effect	Access		After effect
	Policy flexibility	Public-private partnership	Early introduction to ICT			Training				
	Public-private partnership									

These policies are not exhaustive. Some of them repeat in various attributes due to their general application. However the details of these common policies would not be same when applied to their respective attributes. The following are a few quotations from some experts as they talked about policies that can be used to address the attribute of a socio-technical environment.

"Use prototyping and consultations. The policy should be a stake holder approach, consult. If there is a feeling that people don't know what they want then use prototyping."

In the quotation above the expert was expressing the need to have policies that encourage consultations with state holders before addressing any attribute of a socio-technical environment. In the event innovation is ahead of what the client is aware of and even when the needs for the client are well defined, the expert highlighted the need for prototyping as a way to ascertain acceptance of any product by the client.

The researcher needs to underscore the fact that while the given set of attributes can be identical according to literature and results of this research but they manifest differently among different nations, hence the need for consultations first.

"Mentorship programs, incentivize sharing of expert knowledge not necessarily in form of money. We need policies that encourage a sharing of knowledge"

In answering the question of how expert knowledge can be reserved, the expert had the above to say. Policies aimed at sharing of knowledge coupled with varieties of incentives can be a solution.

"The government need to take care of everyone. Flexibility in policies is needed. Policies need to accommodate cultural diversity by being general and inclusive. National policies should uphold the principle and not the specifics"

The expert in the above statement argues that policies need to be made general to uphold the principle and not the specifics. This accommodates globalisation and diversity in a socio-technical environment.

From these findings, the researcher can establish that there are attributes that characterise a socio-technical environment. Some of these attributes have been identified and presented in this research. Some policies to address each of the identified attributes have also been investigated and presented. The objectives of attributes and their intervention have thus been addressed. There could be more attributes, however from the interviews conducted there no new information was coming from participants therefore data saturation was reached.

One other important aspect of a socio-technical environment as given in literature and confirmed by participants is that of the social repercussions. These are negative effects to the social order of the environment which have a human being as an agent. The reason why the researcher has not classified social repercussions as part of the attributes is because these repercussions are not necessarily inherent to the socio-technical environment. These are caused by humans and they partly have a criminal element. Likewise human can decide not them.

The following section discusses these social repercussions in light of the findings of this research.

4.9.3: Social repercussions of a socio-technical environment.

The ubiquitous nature of broadband in information societies comes with negative social consequences. These effects of a socio-technical environment can cost nations more than what they spend to build broadband infrastructure itself. Some of these repercussions are shown in table

4.14 below. These results are a combination of what the experts gave the researcher and results from online survey:

Table 4.14: Social repercussions of a socio-technical environment

Social repercussions							
Cyber bullying	Data confidentiality	Health issues	Isolation	Unemployment	E-Gambling	Indecent content	Abductions
Data Integrity	Data Availability	Indirect effects	Anti-social behavior	Uncultured behavior	Profiteering	Unproductivity	Theft

The social repercussions in Table 4.14 are are just part of the lot but maybe the most significant ones. Each one of the encapsulates numerous variations of the same. Cyber-crime costs nations a lot of many and always mutates into different forms. Criminals always try to find ways of beating the systems. These repercussions are man made and therefore not natural attributes of a socio-technical environments. Unemployment and isolation may be regarded as attributes and not man made but not exclusively. Unemployment doesn't have to be an issues retaining personnel and redeploying them can always be a solution. Isolation can alsobe avoided by working in teams.

Below are some quotations from interviewed experts on the subject of social repercussions:

"The market always balances itself out. Eg laid off people should upskill themselves. If we don't progress we are doing our society an injustice. We are competing at a world stage. Upskill people. Don't fire people and walk away."

In the above quote the expert was alluding to job losses as a result of broadband or technology in general. He gave a solution of training and redeployment. It is a fact that technology can take some jobs that people mgiht have been doing but as the experts have said that technology can not completely replace humans. In other areas of the supply and demand chain humans are needed. The key is upskilling the redundant employees to increase their relevance in other areas.

"Gossip at work place. Productivity at workplace can be affected by spending lots of time on social media."

This speaks to unproductivity as one of the repercussions of a socio-technical environment due to wasting time social media. Some companies resort to banning social media at work places but still

find out that the benefits of using it outweighs its negative effects in terms of unproductivity. Better solutions are discussed in section 4.9.4 under policies that address these repercussions.

"Some use ICT to do illegal or immoral things like online divorce, cyber bullying, isolation, kids and parents don't know each other anymore"

The expert quoted above mentioned uncultured behaviour, crime and indirect effects of a socio-technical environment. All of these repercussions had their solutions discussed in section 4.9.4. In many societies it's uncultured to divorce someone online. Worse still some discover that they have been divorced without their knowledge. Like one expert said that "we can't regulate values", it becomes difficult to regulate the conduct of cyber users. Isolation, false company and lack of direct fellowship among family members in the same space become some of the indirect repercussion of a socio-technical environment. Cyber-crime takes many forms and some of them apart from bullying include, false identity, e-gambling, indecent content, false terror alerts among others. Data confidentiality, integrity and availability summarize data security in cyber space and is mostly concerned with data in transit.

The list of social repercussions is endless but the cardinal ones have been identified in an attempt to answer the research of social repercussions. The proposed framework for broadband growth and penetration in SADC requires these repercussions to be identified. However identifying them alone may not help decision makers on how to curb them. For that reason 4.9.4 below discussed the policies that should address these social repercussions.

4.9.4: Policies that address social repercussions of a socio-technical environment

Most repercussions of a cyberspace have an element of criminality and can almost all be avoided. The proposed framework for broadband growth and penetration in SADC was necessary because solutions in the form of policies may be sought after to address these social ills in our socio-technical environments. So policy propositions that were suggested by participants are discussed in this section. These should help decision makers who may find the proposed framework useful for them.

Table 4.15(a) and Table 4.15(b) below presents the social repercussions that were identified by participants as present in a socio-technical environment and the suggested policy interventions that can be used to address each one of the repercussions.

Table 4.15(a): Policies for social repercussions

Social repercussions								
Conformity to Technology	Cyber bullying	Data confidentiality	Health issues	Isolation	Unemployment	E-Gambling	Indecent content	Abductions
Policies for Social repercussions								
Consultations	Human rights	White hat hackers	Work gym	Team work	Training	Traffic monitoring	Traffic monitoring	Traffic monitoring
Reciprocity	Education	Education	Education	Education	Education	Education	Education	Education
prototyping	Traffic monitoring	Encryption	Wellness campaign	Mentorship	Up skill	Law enforcement	Law enforcement	Law enforcement
Cultural values					Redeployment			

Table 4.15(b): Policies for social repercussions

Social repercussions							
Data Integrity	Data Availability	Indirect effects	Anti-social behavior	Uncultured behavior	Profiteering	Unproductivity	Identity Theft
Policies for Social repercussions							
Encryption	Secure networks	Education	Psychological evaluation	Education	Price control	Targets	Passwords
Secure networks	White hat hackers	Team work	Mentorship	Mentorship	Penalties	Incentivize	Best practices
White hat hackers		Wellness campaign	Team work		Competition	Training	White hat hackers
		Education	Education			Performance management	

The following quotations are extracts from the primary documents of responses given by some experts to various interview questions.

In response the question of negative social effects of broadband and the possible solution to that the expert said the following:

"There are supposed to be rules in using technology. Some use ICT do illegal or immoral things like online divorce, cyber bullying, isolation, kids and parents don't know each other anymore. Educate people also about the bad side of technology."

In this response the expert called for a balance between the implementation of broadband and an equally important implementation of the educational programs on correct and incorrect use of it. Here the experts indicates that the gains intended to be achieved by such technological developments can be reversed by lack of education about the same development. Education has been the preeminent solution to many attributes. Targeted education to address the ills of misuse of broadband is needed from the expert's point of view

On the question of reciprocal shaping between technology and society, one expert had this to say:

"I don't know if I agree with reciprocal shaping. According to me, society balances itself out. Unsuitable inventions or technology will naturally be damped. To policy that can be counter development. Regulation should be after the fact to guard fundamental human rights."

According to this expert, there need not be any regulation on technological development beforehand but rather after the event. Regulation of inventions before they are done is counterproductive, the expert said. This is a remarkable contribution by this expert. The researcher concludes that even regulation that is done after the event will still affect new events therefore the effect is the same expect in areas where regulation does not yet exist.

On the same question of relationship between technology and society, another researcher had the following to say:

"It depends on the type of technology. Society has requirements and manufacturers tend to take these requirements in their products. Manufacturers do their research and do production without consulting but society accepts it. Others can be refuted due to societal beliefs and values eg, abortion, genetic manipulation, human being cloning. There is no one way fits all. The two need to be in a reciprocal shaping because technology is meant to serve people and not people technology, to maintain a balance of values."

The researcher acknowledges the above response as striking its balance between control and liberalism. Indeed not technologies are the same and broadband based technologies are vast and different. Steve Jobs once said "A lot of times, people don't know what they want until you show it to them." (Bariso 2014). This concurs with the expert's response on society accepting new products made without market research. At the same time the expert is acknowledging the need for consultation pointing that it depends on the type of technology involved. The pivotal point the expert makes is that technology should serve people and not the other way round.

"The two should be in reciprocal shaping relationship. Should we let technology dominate over us, we would be simply giving away our God given privilege of interacting with others in a sense that people would use emails, texting, calling, etc, as means of communication only and we would lose in-person communication of which is very vital to human kind in my opinion"

The above quote emphasises reciprocal shaping of the two with special reference to values. This points to culture. The experts gave pre-eminence to human values. The researcher interprets to mean the need of consultations or market research before implementing some technologies.

"Technology should not be a garget but a solution to a problem. That's the solution. So any piece of technology that does not answer to problems of society at hand then it's not useful. Therefore society should come first in every case. Technology should come to fill a gap but at the end, the solution should benefit society. Eg etolls, it's a good technology but it's not filling the gap. Society does not need it. There should be another model."

The expert quoted above focuses on the ultimate end and that is in the final analysis, any technology should fill a gap in society otherwise it is irrelevant. In terms of how technology can fill the gaps without compromising existent societal norms and values, there are trade-offs that can be done, hence the need for consultations.

Chart 4.4 on technology-society relationship reveals that the majority of respondents are of the opinion that society should take credence over technology. The researcher therefore has reason to accept that in SADC society takes precedence over technology.

In this last section findings have shown that there are social repercussions that are a result of a highly technical social environment. It can be noted by the researcher that in Table 4.14 and Chart 4.2, more than 75% of these repercussions are criminal in nature and require law enforcement

mechanisms to handle them. Other repercussions are health, values, cultural and job security issues.

The policy interventions as shown in Table 4.15(a) and 4.15(b) range from performance management policy to data security policies, from education and training policy to wellness campaign policy and many more. About 54 different policies were identified by the researcher from the responses given. One peculiar policy that is controversial is one of traffic monitoring.

From a business viewpoint there are massive advantages to monitoring employees. Managers must have an insightful approach to addressing the issue, the extent of what they will screen, how they will screen who will be screened, and how it will be financed (Bezek, Britton, 2001). Most workers would not be for the idea of screening, however businesses need a framework set up to guarantee profitability. Learning administration frameworks set up can successfully help an association monitor employees and give advantages of enhanced execution, and expanded hierarchical mindfulness (Oprea, 2012). Satisfactory use policies are a standout amongst the most well-known organisation arrangements. The assignment of making and upgrading Acceptable Use Policies to address employee observing and security issues ought not to lay on the IT Department alone as by Duermyer (2007). Rather, should be a cross-departments collaboration that incorporates, agents from HR and if accessible, legal department, alongside contribution from the IT department (Yerby 2013)

4.5: Conclusions

In conclusion, the results of this research have confirmed the factors that affect broadband growth and penetration, especially in SADC region. The attributes inherent to a socio-technical environment were identified by sample of participants both through interviews and online survey. Social repercussions associated with a socio-technical environment were identified and policy solutions to these repercussions were proposed. A framework for broadband growth and penetration was developed and populated by these results and used to enhance BGP.

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

5.1: Introduction

This chapter comprises a compound summary of the entire research work conducted and the recommendations for future studies in line with this research. The chapter covers the depth and breadth of this study from chapter one to four. The aim of this chapter is to highlight the conclusions of the whole study by answering the primary research question guided by the secondary questions. This was achieved by drawing inferences and meta-inferences from the results of data analysis. These inferences were made per research question.

After answering the research questions and drawing meta-inferences validation of the study is discussed in section 5.3. An integrative validation framework used was explained and integrative efficacy was discussed.

Major contributions of this research to the body of knowledge and the practical applications of the research results are given in section 5.5. Limitations of this research and recommendations for future work are the last points of discussion in this chapter.

This research was motivated by a statistically proven reality of broadband growth and penetration within Africa in general and SADC region in particular (ITU 2013). The paucity of a people oriented framework for broadband growth and penetration was identified by the researcher as the main contributing factor. So the journey of this research began with research questions.

5.2: The research questions

The value of broadband in today's knowledge based economies was discussed in section 2.4.3 of this thesis. It is disenfranchising for the people of Africa to have less than sixty five percent broadband penetration rate. Information societies carry a promise of affordable and ubiquitous connectivity for economic growth, health and industry facilitation, education, leisure and improved quality of life. Third world economies have been deprived of these common goods hence motivation for this research under the following research questions.

The primary research question is:

How can Broadband Growth and Penetration (BGP) in the SADC region be increased?

The secondary research questions are:

1. What latent factors are influencing broadband growth and penetration in SADC?

2. How do BGP factors correspond to each sub systems of the Socio Technical Theory (STT)?

3. How do the factors identified conform to gathered data?

4. What interventions are needed to increase BGP in SADC?

5. How do policies per given factor relate?

6. What are the most influencing factors of BGP in SADC?

7. What attributes and social repercussions are inherent to and caused by broadband growth and penetration?

8. What policies are needed to address the attributes and social repercussions of a Socio-Technical environment?

The whole research revolved around the primary research question on how to improve broadband growth and penetration in SADC. This study sought to come up with innovative ways to improve BGP through a proposed framework. The answer to this research question is a practical framework, which when implemented should result in improved broadband penetration. Although the framework encapsulates both broadband growth and penetration issues, the ultimate goal is penetration. This is because availability of broadband without being used does not benefit anyone.

The main research question was answered through secondary research questions. Each secondary research question addresses a particular component of the proposed framework. Therefore the adequacy with which every question is answered impacts on the efficacy of the proposed framework.

5.3. Answers to research questions and inferences.

In this section each research question is examined in terms of its intention, the obtained answers and the inferences that the researcher made from the given answers. This was done both for quantitative and qualitative questions separately. At the end of this section, after all separate inferences were made, met-inferences were then made that cut across both quantitative and qualitative inferences. Inferences are defined as the researcher's construction of the interrelationships among variables characterizing a phenomenon including his or her construction of respondents' perceptions of the same phenomenon (Tashakkori & Teddlie 2003).

5.3.1.: What latent factors are influencing broadband growth and penetration in SADC?

As shown by many studies including Flamm and Chaudhuri (2007), there exist factors that influence broadband growth and penetration. A detailed literature review of these factors was done in section 2.6.1. This research question sought to categorise factors that are given by literature. The answer to this question is found in the standard theory that was used as the lens of this research, the socio-technical systems theory. This theory allowed the researcher to identify the BGP factors as belonging to the social, technological or the environmental subsystems of the theory. The researcher added another subsystem to the three given by the theory; industry as discussed in section 2.7.

Inference No. 1

The subsystems referred to in STST are the actual latent factors that influence broadband growth and penetration. Therefore, addressing these latent factors addresses the actual problem of broadband growth and penetration.

5.3.2: How do BGP factors correspond to each sub systems of the Socio Technical Theory (STT)?

This research question sought to understand which of the BGP factors correspond to which subsystem of the STS. This categorisation of the BGP factors was fully achieved by the answer to

research question three which sought the best fit of these factors into their categories using Confirmatory Factor Analysis (CFA) as discussed in section 4.4. The following inference can however, be drawn from the answer to research question two.

Inference No.2

BGP factors that influence broadband growth and penetration can be categorised into these latent factors of the socio-technical systems theory which are social, technological, environmental and industrial factors.

5.3.3: How do the factors identified conform to gathered data?

In posing this research question the researcher was attempting to not only present factors given by literature as the ultimate factors that influence broadband growth and penetration but rather test them first by asking SADC participants to conclude if indeed these factors are the ones. Room was given for participants to suggest other factors which might not be found in literature. The BGP factors as suggested by literature were all confirmed by field data and fitted acceptably within their latent variable as in Fig 4.2. The factor loadings were all above 0.4 and three indices of fit were used. For the best fit model the Chi square value was about 330. This value was affected by large sample size but was compensated for by other three indices, the RMSEA of 0.54, a CFI of 0.937 and GFI of 0.935. The full analysis of this measurement model was given in section 4.4 of this thesis

Inference No.3

BGP factors that are in literature were confirmed by participants in SADC

5.3.4: What interventions are needed to increase BGP in SADC?

In section 4.7, chart 4.1 shows the results regarded as measures for increasing broadband growth and penetration. About more than 50% of the respondents mentioned the following measures or interventions: wifi access, access, government policies, investment, rural areas and connectivity. These measures can be implemented as policies and all the listed policies promote growth of broadband, they are infrastructural in nature. Of course government policies may not necessarily only be broadband growth policies, they may as well be penetration policies. The researcher called the growth policies, business policies. The rest of the other measures mentioned in chart 4.1

promote broadband penetration. These are in relation to how many people are actually using broadband once it is available. The researcher called these policies, social policies. These measures are cost, education and training. The availability of broadband does not necessarily imply the usage of it, therefore broadband growth does not always imply broadband penetration, though we can't have broadband penetration without broadband growth. The researcher notes that policy on cost can be both be business and social and that can be true for other policies as well. However, business policies have been in use for long in the conventional broadband frameworks that have shown not to be working so well for Africa according to statistics. Therefore in spite of the overlap of policies the main interest is in the social policies.

Inference No. 4

Broadband growth and penetration can be increased by implementation of both business and social policies.

5.3.5: How do policies per given factor relate?

As was discussed in section 1.2 on problem definition, the current model used for broadband growth and penetration is presumed that social relationships are easily reformed to take advantage of the broadband conveniences and business value, expertise is easily made explicit, IT infrastructure is fully supportive and technological effects are direct and immediate (Shin 2012). This research has revealed otherwise, in that social policies are as important as business policies for broadband growth and penetration.

In section 4.5, Table 4.9 and 4.10 the results of policy ratios are presented. It is interesting to note that for broadband growth factors in Table 4.9, SADC participants indicated that business policies should be more dominant to social policies. The results show that for every social policy there is need for two business policies, giving a ratio of half.

However, in Table 4.10 showing broadband penetration factors, SADC suggested more social policy for every factor. The ratio is two social policies for every business policy.

Inference No. 5.

Within SADC region more business than social policies are needed to promote broadband growth and more social than business policies are needed to promote broadband penetration.

Inference number five above speaks directly to the history, culture and contextual setting of SADC. Historically, the people have been impoverished by their colonial past. As a result, for them to be able to adopt and use broadband social issues at play need to be addressed. Such issues include affordability, ability to use broadband and the need to use broadband. Culturally, some social values constrain them, security issues are a concern and training.

5.3.6: What are the most influencing factors of BGP in SADC?

This question intended to rank factors of BGP irrespective of whether they are growth factors or penetration factors. The answer to this question is found in Fig 4.3 of factor ranking. The most significant factor according to these results is cost of the internet in SADC, followed by level of education. Urbanisation, GDP per capita and user friendliness of the Internet respectively are the three next influential factors. These are the top five most significant factors for BGP in SADC. The least significant factor among the eighteen identified factors is religious beliefs.

Inference No. 6

The two most significant inhibitors of broadband growth and penetration within SADC are cost of broadband and level of education.

5.3.7: What attributes and social repercussions are inherent to and caused by broadband growth and penetration?

This research question sought to unearth the inherent characteristics that naturally come with a socio-technical environment. Such qualities that are associated with a socio-technical environment need to be provided for, as a way of building a conducive environment for broadband to thrive. The aspect to this question is the social repercussion of a socio-technical environment. These are the negative effects of a socio-technical environment which in some case manifest as criminal activities, health issues and job security issues among many.

Table 4.13 and Table 4.14 identify the attributes and social repercussion together with the suggested policy interventions.

Inference No. 7a

A socio-technical environment has attributes that are inherent.

Inference No. 7b

A socio-technical environment can have negative social effects which are both criminal and non-criminal.

5.3.8: What policies are needed to address the attributes and social repercussions of a Socio-Technical environment?

This question was looking for solutions to the attributes and social repercussions of a sociotechnical environment. Pre-empting and putting in place the solutions to these conditions ensures a well galvanised environment for broadband uptake. These solutions as suggested by SADC participants are in Table 4.13 and Table 4.15.

Inference No. 8

A socio-technical environment needs policies that address its natural attributes and the negative activities that can be found in it.

From the given inferences above that seem to be independent of each other, the researcher delves to establish meta-inferences that cut across all the mentioned ones. Meta-inferences tend to theory building in mixed methods research. Unlike separate inferences in section 5.3, the meta-inferences tend to be general and may not speak to the specifics of an objective. Some meta-inferences given in section 5.4 below encompass more than one objective.

5.4 Meta-inferences

Meta-inference is defined as theoretical statements or narrative which are derived from an integration of findings from both quantitative and qualitative research (Venkatesh et al. 2013). Meta-inferences are critical for mixed methods research lest the whole purpose of mixed methods is defeated. Meta-inferences can be described as integrative conclusions that combine both findings to build theory. These integrative conclusions do not necessarily mean that qualitative and quantitative findings should produce the same understanding. There is room for divergence (Tashakkori & Teddlie 2008; Teddlie & Tashakkori 2009).

According to Venkatesh and other (2013), the analysis path could be one of the following, depending on the mixed methods design strategies:"

- Merging of qualitative and quantitative findings → meta-inferences
- Quantitative findings → qualitative findings →meta-inferences
- Qualitative findings →quantitative findings →meta-inference."

This research used a concurrent strategy and therefore, used the first path. The following are meta-inferences that come from stand-alone inferences given in section 5.3.

Meta-inference 1

In order to get an accurate determination of variables that affect broadband growth and penetration within a people group consultation is necessary. (Objective 3)

Meta-inference 2

Some factors of BGP in the quantitative study also manifest themselves as attributes and repercussions in the qualitative strand. Examples of these are cost, security also manifesting as data confidentiality in the qualitative strand, and education manifesting as technophobia or resistance to change in qualitative strand.

Therefore, in a broader sense attributes and social repercussions of a socio-technical environment form part of the factors that influence BGP. (Objectives 1 and 7).

Meta-inference 3

Attributes, social repercussion of socio-technical environment and BGP factors though address different aspects of the BGP framework all contribute to the same holistic framework. (Objective 2)

Meta-inference 4

Some policies that are needed to address attributes and social repercussion of a socio-technical environment are similar to those needed to address some BGP factors. (Objective 4 and 8)

Meta-inference 5

The BGP factors, attributes and social repercussions are all contained within a socio-technical environment and belong to at least one of the subsystems of a STST. This makes them an ecosystem. Therefore, an effect on one impacts on the others. (Objective 2)

Meta-inference 6

Broadband penetration and social repercussions require more social policies than business and broadband growth and attributes require more business policies than social. (Objectives 5 and 6)

The following section 5.5 gives the contribution of this research to the body of knowledge through a series of questions that the research used to evaluate his own work.

5.5: Contributions to the body of knowledge.

The proposed framework is something new in its approach to the question of broadband growth and penetration as seen by its inclusive nature of the economic convectional model and the social aspect in the same broadband framework. The socio-technical environment attributes and social repercussion as well as interventions to address them have never been explored before. The interaction between society, technology and policy has been studied and there is literature available, however, much is yet to be done on the development of a comprehensive framework and its differential application to problem domains. So this known information will be integrated into knowledge applicable to solve the research question.

According to Mavetera 2011, a PhD level study is an iterative and systematic learning process. This process can either culminate in generation of or testing of already existing theory. In the whole process new knowledge is generated which enriches a discipline.

1. Was the research problem addressed towards a continuing questions in the discipline?

Section 5.3 presented the research questions that guided this research. All the research questions inherited from the primary research question: How can broadband growth and penetration be increased in SADC? In answering each of the secondary reseach questions inferences were made. These are the researcher's construction or conclusions of the narratives of the participants in

response to surveys and interviews aimed at addressing each research question. The inferences were given firstly for the qualitative and quantitative research strands separately. Then meta-inferences were drawn from the integration of inferences from both strands.

The answers from research questions formed the building blocks for the SADC framework of broadband growth and penetration. These responses were at times contrasting or linking to each other but all infusing to build the framework. The research questions were instrumental to building of the framework in two ways. Firstly, they determined the constructs that formed the structure of the framework itself and secondly they solicited the responses that were were used to populate the proposed framework. Therefore, the uniqueness of the SADC framework lies in its population by the participants responses. Outside of that, the framework remains generic and usable anywhere.

2. Was a suitable methodology of research used?

Appropriateness of research design is central to conducting meaningful research (Mavetera 2011). Research design needs to be informed firstly by the "why" rather than the "how". The "why", gives motivation for research to be conducted. It is the one that identifies a real life problem that needs addressing (Oates 2009). Research methodology answers the how of research and has its groundings in philosophical assumptions. The research framework in terms of its methodology was outlined in Fig 3.2.

Pragmatism was the worldview upon which the methodology was based. Mixed methods approach was decided upon as the research approach after considering the research questions and the objectives of the research. A concurrent strategy was used since the the two srands were conducted at he same time and independently of each other. The major determinant for the choice of mixed methods approach was the objective of the research. As discussed, the main purpose for this approach was complementarity and completeness.

3. Is the method used in data analysis suitable and in alignment with the methods used?

The quantitative strand of the research used confirmatory factor analysis (CFA) in SPSS and frequency analysis in survey monkey. Both methods analysed the data in line with the objectives of the research. The measurement model of the structural equation modeling was used for the CFA. The qualitaive part used Atlas.ti Survey Monkey Text Analysis to analyse qualitative responses.

These two methods were necessary to integrate analysis of qualitative and quantitative data as needed in mixed methods research.

4. Has the framework amalgamated different, precious and unrelated problems or concepts? (Introna 1992).

The following problems are addressed by the proposed framework:

a) Accurate knowledge of what are the factors that in fact hinder broadband growth and penetration in SADC. The confirmation of these factors came from the survey.

b) The ranking of these factors which priority of allocation of resource in addressing these factors.
c) The policy interventions needed to address these factors.

d) The relationship between business and social policy interventions.

e) The attributes and social repercussions of of a socio-technical environment.

f) The policies needed to address the attributes and social repercussions of a socio-technical environment.

The researcher submits that knowledge of the mentioned concepts will help decision makers to allocate resources and make policies in knowledge of most needy areas and the type of policies needed to address specific aspects of broadband growth and penetration.

5. Has the framework created new viewpoints on the existing problem

Attempts to solve the problem of low broadband growth and penetration especially in SADC have been the implementation of the conventional business model for broadband uptake. In this current broadband framework being used by the World Bank in many parts of the world broadband is seen as a business tool. In this framework, it is presumed that social relationships are easily reformed to take advantage of the broadband conveniences and business value, expertise is easily made explicit, IT infrastructure is fully supportive and technological effects are direct and immediate (Shin 2012).

Put differently, the prevailing broadband frameworks, not only in SADC but globally lack the inclusion of societal uniqueness and how it relates to technology and its environment as an

important part of the framework. This research used STST to solve the broadband problem and came up with a proposed framework. No such approach and framework have been used before.

6. Has the framework created unusual ideas?

The idea that broadband is a social construction and not just a business tool is unusual. The idea that technology and society need to be in a relationship of reciprocal shaping came from the participants and is unsual. The understanding that technology is meant to serve people and not the other way round was made obvious. Most importantly the adaptability of the framework to any people group by means of populating it with research results every time its used is key to the effectiveness of the framework.

7. Is there enough study of the appropriate literature

The first part of literature review critiqued the obtaining broadband frameworks that are largely informed by the World Bank Broadband Handbook. The weakenesses of these frameworks are highlighted in section 2.6. Then recent studies that have analysed broadband using STST were critiqued in section 2.6.2. The gaps in these researches were identified and a holistic approach to systems thinking was studied, areas of its application and the appropriateness of STST were examined. This resulted in the abstration of the first part of the proposed framework in Fig 2.1.

In conclusion of this section the researcher needs to underscore that proposed framework is applicable at all the three levels of application of STST; primary work systems, organisational systems and macro social systems. Monitoring and enforcement of the principles of this framework is necessary for its successful implementation.

5.6: Limitation of the study

Knowledge obtained from research is never absolute but always realtive and subject to many assumptions, conditions and the researcher's abilities and experiences (Bryman 2008). Limitations are always felt in research (Mavetera 2011) and this research is no exception.

The following limitations are notable in this research:

- ✓ The findings of this research are only aplicable to SADC, therefore generalisability of the results is limited.

- ✓ Of the 13 countries that participated in the survey more than 50% of the participants were from South Africa owing to the location of the researcher. Therefore the distribution in this regard is not normal.
- ✓ The researcher had to travel to five SADC countries to interview the experts in their natural settings and to observe the environments. However, the time of the researcher's visits was so limited that his observations and interviewee followups to confirm the transcribed interviews were not appropriately done.
- ✓ Not all interviewed experts had full knowledge of state of broadband in other SADC countries.
- ✓ Some interviewed experts were hesitant to devulge government ICT policies

5.7: Recommendations for future studies

Future researches in the area of broadband can consider the following areas:

- ✓ Broadband ecnomic enablers

A research that looks at key economic enablers that are based on broadband would help governments on how to grow their economies by fostering broadband in keys areas.

- ✓ Time series research factors of broadband growth and penetration.

This would determine the dynamic aspect of society and business. This evolution of society can be used to extrapolate future trends of factors that influence broadband growth and penetration.

- ✓ Comapring Nations' Absorptive Capacity of Broadband to their GDP per capita

This study can be aimed at system of reference for measurement of absorptive capacity of broadband of various nations and camparing that with their GDP per capita. Such a research will reveal if there is a corelation or causality between a country's absorptive capacity and its GDP per capita.

- ✓ Legal framework for cyber-space

Many nations need a framework that governs their cybe-space. This is better than enacting laws on a reactionary basis.

- ✓ Broadband political enablers

This can look at hoe broadband hasr been used and can be used in future for the rise and fall of political fugures.

5.8: Conclusions

This chapter captured the entire thesis in terms of its research questions, aims and objectives.All research questions were answered and the aim achieved. Factors that influence broadband in SADC have been identied, likewise the interventions needed. The social ills of broadband were highlighted. The developed framework has its strength in its implementation. The researcher intends to take the framework to to various government departments within SADC to show case its importance. In this way the framework can be further refined for its use in SADC. Already, Southern African Telecommunications Association (SATA) has shown interest in this research and the researcher looks forward to engaging with them.

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Annexure 1 Experts' comments on the proposed framework

1. **Suitability of constructs and variables used:**

The constructs used towards constructing the framework are reasonably suitable. I might not be understanding this very well, but the broadband growth and penetration has a lot to do with two things mainly, Technology and People/Communities/Governments and these constructs might be vital to this framework.

2. **Applicability of the framework**

Both parts of the framework look and sound appropriate for the broadband growth and penetration as they display attributes for such capability. There might be a need to describe aspects of the framework's applicability to broadband growth and penetration in general.

3. **Relevance of the Framework to the problem under investigation**

The framework has some relevance to the problem under investigation from perspective of understanding factors that affect broadband growth and penetration in Southern African Development Community (SADC).

4. **Match between methodology of research used and the resulting framework**

The mixed methodology approach combines various qualitative and quantitative methods which is suitable for socio-technical aspects of the framework as well as values and factors underpinning the framework.

5. **Recommendations**

There is a need for clarity on the components of the framework to guide the user in terms of inputs and what the expected outcomes could be. This will enhance the usability and applicability of the framework significantly. There is also might be a need to build relationship matrix between the two parts of the framework to associate one dimension to the other. Lastly, is this framework used by people, companies, governments or who are the key custodians of the framework?

Title: DR. **Name:** Motse **Surname:** Tsoyang

Signature

My comments with regards to some of the constructs of the Decision-Making broadband Framework are as follows:

- **Society Subsystem Factors**

Societal factors are important in the broadband decision making as it is associated with culture, affordability and literate level. The adoption of broadband in any society is by several societal variables. I therefore support that the society factors are important in broadband decision making.

- **Environment Subsystem Factors**

Government policies and regulations have an influence in broadband penetration. Each country has its policies which inhibit or promote broadband. In many country policies such a sharing of infrastructure are mandatory and tariffs are set the government. So there many different environment factors that influence broadband.

- **Technology Subsystem Factors**

Technology investment is important for broadband in any country. Old technology may not be compatible with new technology. The investment in new technology is important in that it allows compatibility with new technology.

- **Industry Subsystem Factors**

Competition in the industry is important factor in broadband since customers will be able to get a better price. In countries where there is monopoly in the telecom industry, the price of telecom services is higher than the international average.

Dr O. Jokonya

Annexure 2: Ethical Clearance Certificate

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ETHICS APPROVAL OF PROJECT

The North-West University Research Ethics Regulatory Committee (NWU-RERC) hereby approves your project as indicated below. This implies that the NWU-RERC grants its permission that provided the special conditions specified below are met and pending any other authorisation that may be necessary, the project may be initiated, using the ethics number below.

Project title: Towards an adaptive Socio-Technical Broadband Growth and Penetration (BGP) framework: A case of SADC.

Project Leader: Prof N Mavoa & Dr M Velempini
Student: K Gongera

Ethics number: N W U - 0 0 1 1 4 - 1 5 - A 2

Approval date: 2015-04-01 **Expiry date:** 2020-03-31

Special conditions of the approval (if any): None

General conditions:
While this ethics approval is subject to all declarations, undertakings and agreements incorporated and signed in the application form, please note the following:
- The project leader (principal investigator) must report in the prescribed format to the NWU-RERC:
  - annually (or as otherwise requested) on the progress of the project.
  - without any delay in case of any adverse event (or any matter that changes the ethical principles during the course of the project.
- The approval applies strictly to the protocol as articulated in the application form. Would any changes to the protocol be deemed necessary during the course of the project, the project leader must apply for approval of these changes at the NWU-RERC. Would there be deviations from the project protocol without the necessary approval of such changes, the ethics approval is immediately and automatically forfeited.
- The date of approval indicates the first date that the project may be started. Would the project have no contact with participants before the expiry date, a new application must be made to the NWU-RERC and new approval received before contact with participants may be established after the expiry date.
- In the interest of ethical responsibility the NWU-RERC retains the right to:
  - request access to any information or data at any time during the course or after completion of the project.
  - withdraw or postpone approval if:
    - any unethical principles or practices of the project are revealed or suspected.
    - it becomes apparent that any relevant information was withheld from the NWU-RERC or that information has been false or misrepresented.
    - the required annual report and reporting of adverse events was not done timely and accurately.
    - any institutional, rules, national legislative or international conventions deem it necessary.

The Ethics Committee would like to remain at your service as scientist and researcher, and wishes you well with your project. Please do not hesitate to contact the Ethics Committee for any further enquiries or requests for assistance.

Yours sincerely

Linda du Plessis

Prof Linda du Plessis
Chair NWU Research Ethics Regulatory Committee (RERC)

Annexure 3: Survey questions

Broadband Growth and Penetration in SADC

* 1. Which African country are you from?

Countries

Choose country

2. How would you categorize yourself among the following?:

- IT expert
- IT university/college student
- IT technician/IT support
- End user

3. How would you describe your position at work?

- Strategic position
- Management
- Workforce
- University Student

Other (please specify)

4. Which ones of the following factors do you think influence broadband growth? Note: By broadband growth we mean how far geographically internet infrastructure has reached in a given area. Tick/check the boxes of your choices

- [ ] Willingness by government to invest in Information and Communications Technology (ICT).
- [ ] Geographical landscape of the area in need of internet.
- [ ] Private investment in ICT.
- [ ] Internet laws at play in a given country.
- [ ] Government subsidies in private ICT companies.
- [ ] Willingness of private ICT companies to uphold national agendas.
- [ ] Net neutrality (equal access to the internet by all service providers).

Other (please specify)

5. How would you score/scale the factors you identified in question 4 above? You can indicate your score by ticking the appropriate radio button for each factor. Note: ticking the first button means a score of 1, the second, a score of 2 and so on. The highest influencing factor/s can only have a maximum of 8 scores, i.e last button ticked. Different factors can have the same score.

	1 score	2 scores	3 scores	4 scores	5 scores	6 scores	7 scores	8 scores
Willingness by government to invest in Information and Communications Technology (ICT).	○	○	○	○	○	○	○	○
Geographical landscape of the area in need of internet.	○	○	○	○	○	○	○	○
Private investment in ICT.	○	○	○	○	○	○	○	○
Internet laws at play in a given country.	○	○	○	○	○	○	○	○
Government subsidies in private ICT companies.	○	○	○	○	○	○	○	○
Willingness of private ICT companies to uphold national agendas.	○	○	○	○	○	○	○	○
Net neutrality (equal access to the internet by all service providers).	○	○	○	○	○	○	○	○
Other	○	○	○	○	○	○	○	○

Other (please specify)

6. Research has shown that in order to address each of the given factors above, intervention in form of social and business polices is necessary. In your opinion, for each of the factors identified in question 5 above, which type of policies do you think are needed more, social or business? Choose from the following ratios of social to business policies. (1:2 means that for every one social policy we need two business policies and 2:1 means that for every two social policies we need one business policy)

	1:3	3:1	1:2	2:1	1:1	Other ratio
Willingness by government to invest in Information and Communications Technology (ICT).	○	○	○	○	○	○
Geographical landscape of the area in need of internet.	○	○	○	○	○	○
Private investment in ICT.	○	○	○	○	○	○
Internet laws at play in a given country.	○	○	○	○	○	○
Government subsidies in private ICT companies.	○	○	○	○	○	○
Willingness of private ICT companies to uphold national agendas.	○	○	○	○	○	○
Net neutrality (equal access to the internet by all service providers).	○	○	○	○	○	○
Other.	○	○	○	○	○	○

Other (please specify)

7. Which ones of the following factors do you think influences broadband penetration? Note: By broadband penetration we mean how many people are using the internet in a given area. Tick/check the boxes of your choices.

- [ ] Gross Domestic Product (GDP) Per Capita of a country.
- [ ] Cost of using the internet.
- [ ] Level of education of the people expected to be using the internet.
- [ ] Urbanization of the society.
- [ ] History of the people expected to be using the internet.
- [ ] Culture of the people expected to be using the internet.
- [ ] Demography of the internet users.
- [ ] Privacy and security concerns of using the internet.
- [ ] Relevance of services and content found on internet.
- [ ] User friendliness of the internet.
- [ ] Religious beliefs.

Other (please specify)

8. How would you score/scale the factors you identified in question 7 above? You can indicate your score by ticking the appropriate radio button for each factor. Note: ticking the first button means a score of 1, the second, a score of 2 and so on. The highest influencing factor/s can only have a maximum of 11 scores, i.e last button ticked. Different factors can have the same score.

	1 score	2 scores	3 scores	4 scores	5 scores	6 scores	7 scores	8 scores	9 scores	10 scores	11 scores
Gross Domestic Product (GDP) Per Capita of a country.											
Cost of using the internet.											
Level of education of the people expected to be using the internet.											
Urbanization of the society.											
History of the people expected to be using the internet.											
Culture of the people expected to be using the internet.											
Demography of the internet users.											
Privacy and security concerns of using the internet.											
Relevance of services and content found on internet.											
User friendliness of the internet.											
Religious beliefs of users.											
Other.											

Other (please specify)

9. Research has shown that in order to address each of the given factors above, intervention in form of social and business polices is necessary. In your opinion, for each factor identified in question 8 above , which type of policies do you think are needed more, social or business? Choose from the following ratios of social to business policies. (1:2 means that for every one social policy we need two business policies and 2:1 means that for every two social policies we need one business policy and so on)

	3:1	1:3	2:1	1:2	1:1	Other ratio
Gross Domestic Product (GDP) Per Capita of a country.	○	○	○	○	○	○
Cost of using the Internet.	○	○	○	○	○	○
Level of education of the people expected to be using the Internet.	○	○	○	○	○	○
Urbanization of the society.	○	○	○	○	○	○
History of the people expected to be using the Internet.	○	○	○	○	○	○
Culture of the people expected to be using the Internet.	○	○	○	○	○	○
Demography of the Internet users.	○	○	○	○	○	○
Privacy and security concerns of using the Internet.	○	○	○	○	○	○
Relevance of services and content found on Internet.	○	○	○	○	○	○
User friendliness of the Internet.	○	○	○	○	○	○
Religious beliefs.	○	○	○	○	○	○
Other.	○	○	○	○	○	○

Other (please specify)

10. Do you think the past of a people group influences their perception and utilization of the Internet?

- ( ) Yes
- ( ) No

Other (please specify)

7

11. In your opinion, does the colonial past of Africa have anything to do with Africans' ability, perceptions and utilization of the Internet?

- ( ) Yes
- ( ) No

Other (please specify)

* 12. Of all the factors identified in questions 4-9, indicate 5 most influential factors of broadband growth and penetration.

- [ ] Gross Domestic Product (GDP) Per Capita of a country.
- [ ] Cost of using the Internet.
- [ ] Level of education of the people expected to be using the Internet.
- [ ] Urbanization of the society.
- [ ] History of the people expected to be using the Internet.
- [ ] Culture of the people expected to be using the Internet.
- [ ] Demography of the Internet users.
- [ ] Privacy and security concerns of using the Internet.
- [ ] Relevance of services and content found on Internet.
- [ ] User friendliness of the Internet.
- [ ] Religious beliefs.
- [ ] Willingness by government to invest in Information and Communications Technology (ICT).
- [ ] Geographical landscape of the area in need of Internet.
- [ ] Private investment in ICT.
- [ ] Internet laws at play in a given country.
- [ ] Government subsidies in private ICT companies.
- [ ] Willingness of private ICT companies to uphold national agendas.
- [ ] Net neutrality (equal access to the Internet by all service providers).

13. Which of the following attributes do you think characterize an environment where people use ICT to go about their lives and business? Indicate your choices by checking the boxes.

- [ ] Potentially enormous social repercussions from IT, for example workers being redundant and laid off.
- [ ] Contexts are complex (matrices of businesses, services, people, technology history, location, etc.)
- [ ] Knowledge and expertise are inherently tacit/implicit. To acquire knowledge of an ICT expert, time with the expert is needed as not everything can be written down
- [ ] Socio-technical support is critical for effective IT use
- [ ] Relationships between people and technology are complex, negotiated and multivalent
- [ ] Implementation is an ongoing social process. This means as new technology emerges, new designs and trainings are needed
- [ ] Technological effects are indirect, complicated and involve different time scales.
- [ ] ICT should not always dictate social behavior of people but social values should equally inform ICT designs.

Other (please specify)

14. It has been argued that in a socio-technical environment (environment where people and technology interact), both business and social policies should be implemented to achieve optimum results. In order to address the attributes listed in question 13 above, what type of policies do you think should be implemented?

- ( ) Social policies
- ( ) Business policies

Other (please specify)

15. From the factors listed in questions 4 through 9, state at most 5 factors that affect government, society/consumers and ICT industry at the same time.

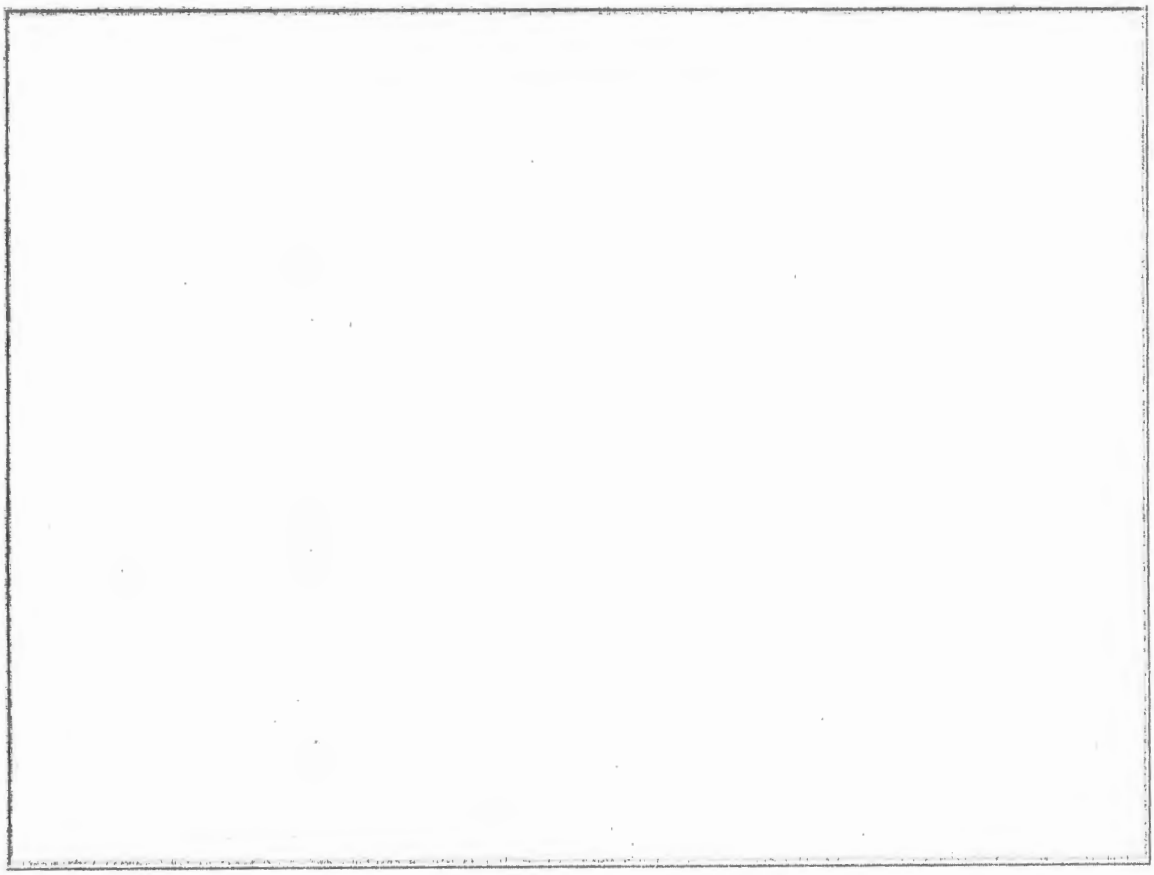
- [ ] Gross Domestic Product (GDP) Per Capita of a country.
- [ ] Cost of using the Internet.
- [ ] Level of education of the people expected to be using the internet.
- [ ] Urbanization of the society.
- [ ] History of the people expected to be using the internet.
- [ ] Culture of the people expected to be using the internet.
- [ ] Demography of the internet users.
- [ ] Privacy and security concerns of using the internet.
- [ ] Relevance of services and content found on internet.
- [ ] User friendliness of the internet.
- [ ] Religious beliefs.
- [ ] Willingness by government to invest in Information and Communications Technology (ICT).
- [ ] Geographical landscape of the area in need of internet.
- [ ] Private investment in ICT.
- [ ] Internet laws at play in a given country.
- [ ] Government subsidies in private ICT companies.
- [ ] Willingness of private ICT companies to uphold national agendas.
- [ ] Net neutrality (equal access to the

Other (please specify)

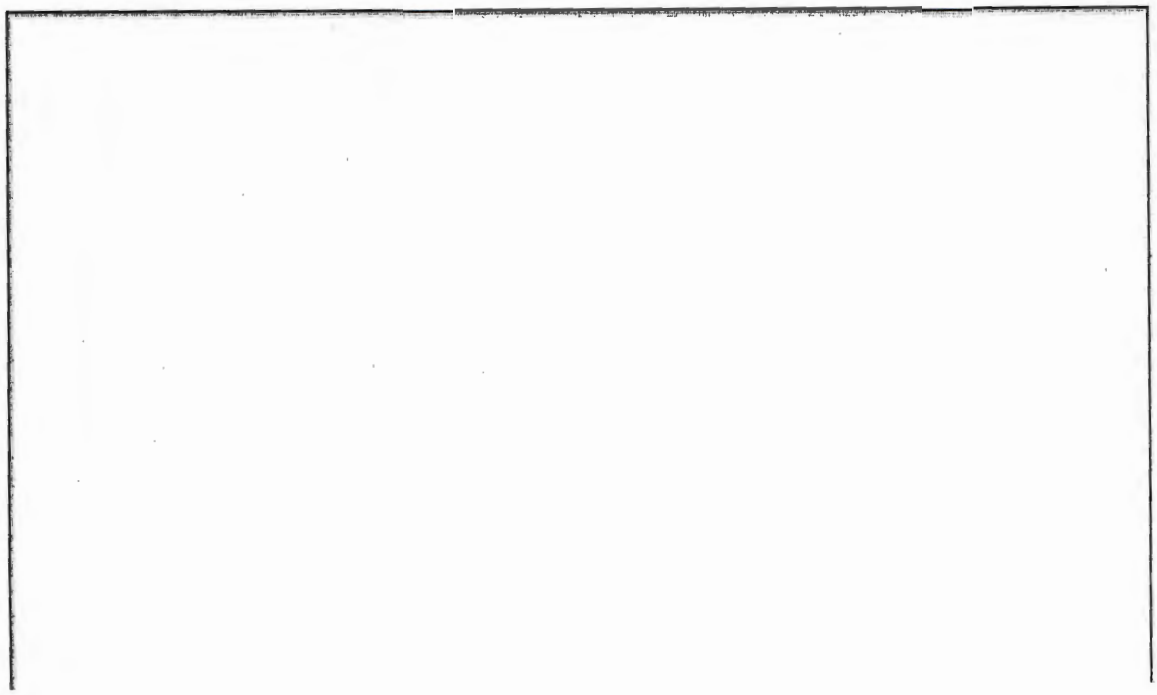
16. In your own words what do you suggest that governments should do in order to improve usage of internet by citizens?

17. Digitization and computerization of services has social repercussion among workers and customers. which are some of this repercussions in your opinion?

18. What are some of the policies do you think companies and governments need to implement in order to curb the social repercussions caused by computerization of services?



19. How would you address techno-phobia (the fear or dislike of advanced technology) at a work place?



20. Would you say that technological applications have taken into consideration the uniqueness(values, cultures, history, location ect) of people groups among whom the technology is used? If not, what do you suggest should be done to address that problem?

21. Would you say that society needs to conform to technology, technology has to conform to society or the the two should be in a reciprocal shaping relationship and why?

Annexure 4: Interview lead questions

Q1. How do history and cultures of a people group conflict with technology (highly computerized environment)?

Q2. Given such conflict, what policies can address it?

Q3. Viability of business is linked to profits yet some government policies can militate against profit margins. How can that be resolved?

Q4. Some schools of thought suggest that society and technology should be in a relationship of reciprocal shaping. Some say technology must be free to develop in any direction then people should take advantage of technology. What are your thoughts?

Q6. How will the regulation be?

Q7. How can social repercussion of broadband be addressed?

Q8. How about moral decadency in technological use?

Q10 Context are complex, do you think openness of market is an answer to that?

Q11. How can expert knowledge be preserved.

Q12. Indirect effects of technology, what are they and how do you solve that?

Q13. How do we enhance support issues?

Q14. What policies would work well for Africa given business monopoly?

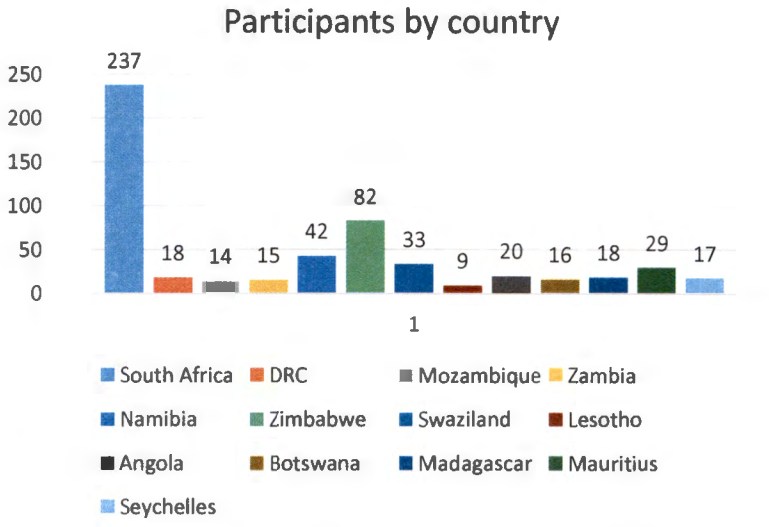
Q15. Society and IT evolve very fast. What can be done to prepare for such fast evolution?

Q16. Relationships are complex, multivalent and negotiated in a socio-technical environment for example job are lost due to technology. What your opinion on this assertion and how would such issues be resolved?

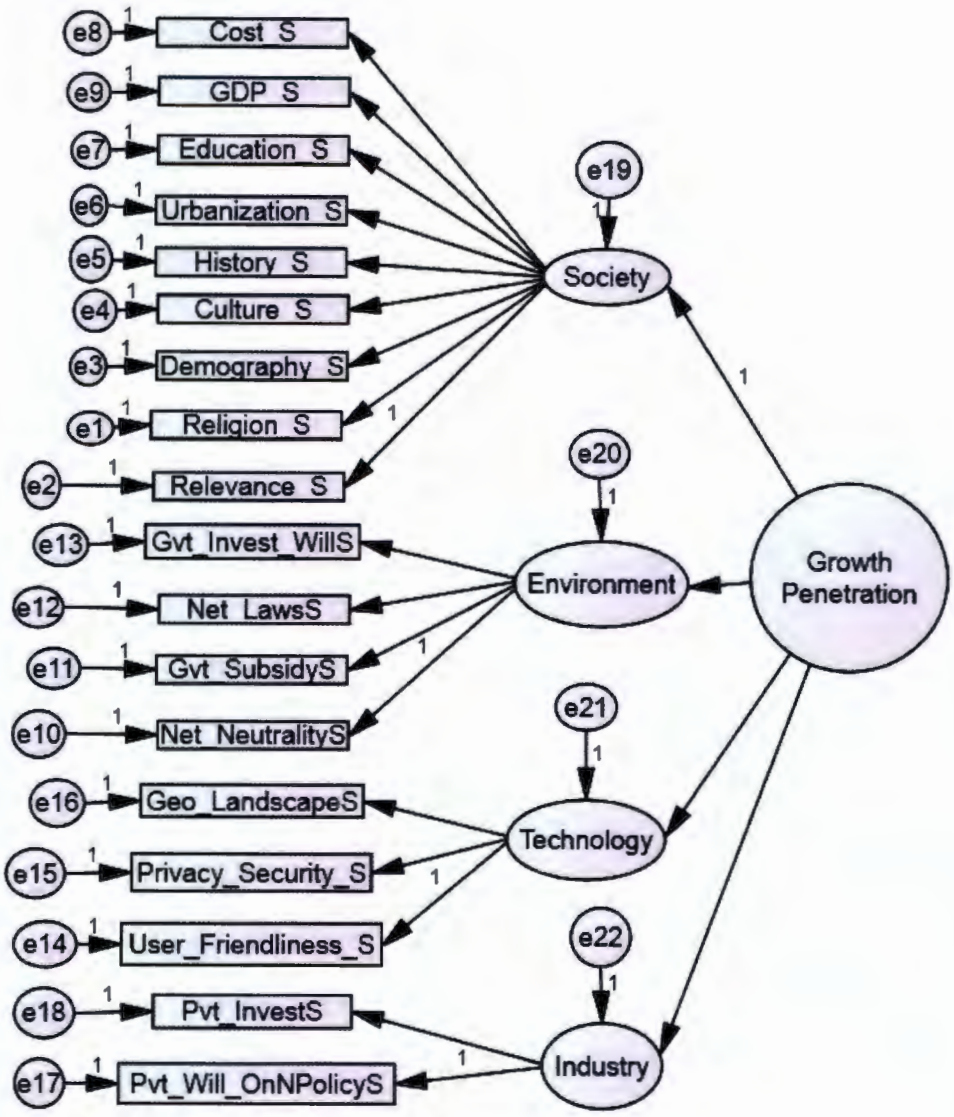
17. How can expert knowledge be preserved?

Appendix 1 Participants by country

		Frequency	Percent	Cumulative Percent
1		237	43.1	43.1
2		18	3.3	45.5
3		14	2.5	48.0
4		15	2.7	50.7
5		42	7.7	55.1
6		82	14.9	60.4
7		33	6.0	66.4
8		9	1.6	68.0
9		20	3.6	71.6
10		16	2.9	74.5
11		18	3.3	78.7
12		29	5.3	84.0
13		17	3.1	90.4
		550	100.0	



Appendix 2 Unmodified model



Model Fit Summary

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	40	459.618	131	.000	3.509
Saturated model	171	.000	0		
Independence model	18	3353.570	153	.000	21.919

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	.535	.911	.884	.698
Saturated model	.000	1.000		
Independence model	3.660	.335	.256	.299

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.863	.840	.898	.880	.897
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	.856	.739	.768
Saturated model	.000	.000	.000
Independence model	1.000	.000	.000

NCP

Model	NCP	LO 90	HI 90
Default model	328.618	267.063	397.762
Saturated model	.000	.000	.000
Independence model	3200.570	3015.839	3392.617

FMIN

Model	FMIN	F0	LO 90	HI 90
Default model	.837	.599	.486	.725
Saturated model	.000	.000	.000	.000
Independence model	6.109	5.830	5.493	6.180

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.068	.061	.074	.000
Independence model	.195	.189	.201	.000

AIC

Model	AIC	BCC	BIC	CAIC
Default model	539.618	542.485	712.014	752.014
Saturated model	342.000	354.260	1078.996	1249.996
Independence model	3389.570	3390.861	3467.149	3485.149

ECVI

Model	ECVI	LO 90	HI 90	MECVI
Default model	.983	.871	1.109	.988
Saturated model	.623	.623	.623	.645
Independence model	6.174	5.838	6.524	6.176

HOELTER

Model	HOELTER .05	HOELTER .01
Default model	190	205
Independence model	30	33

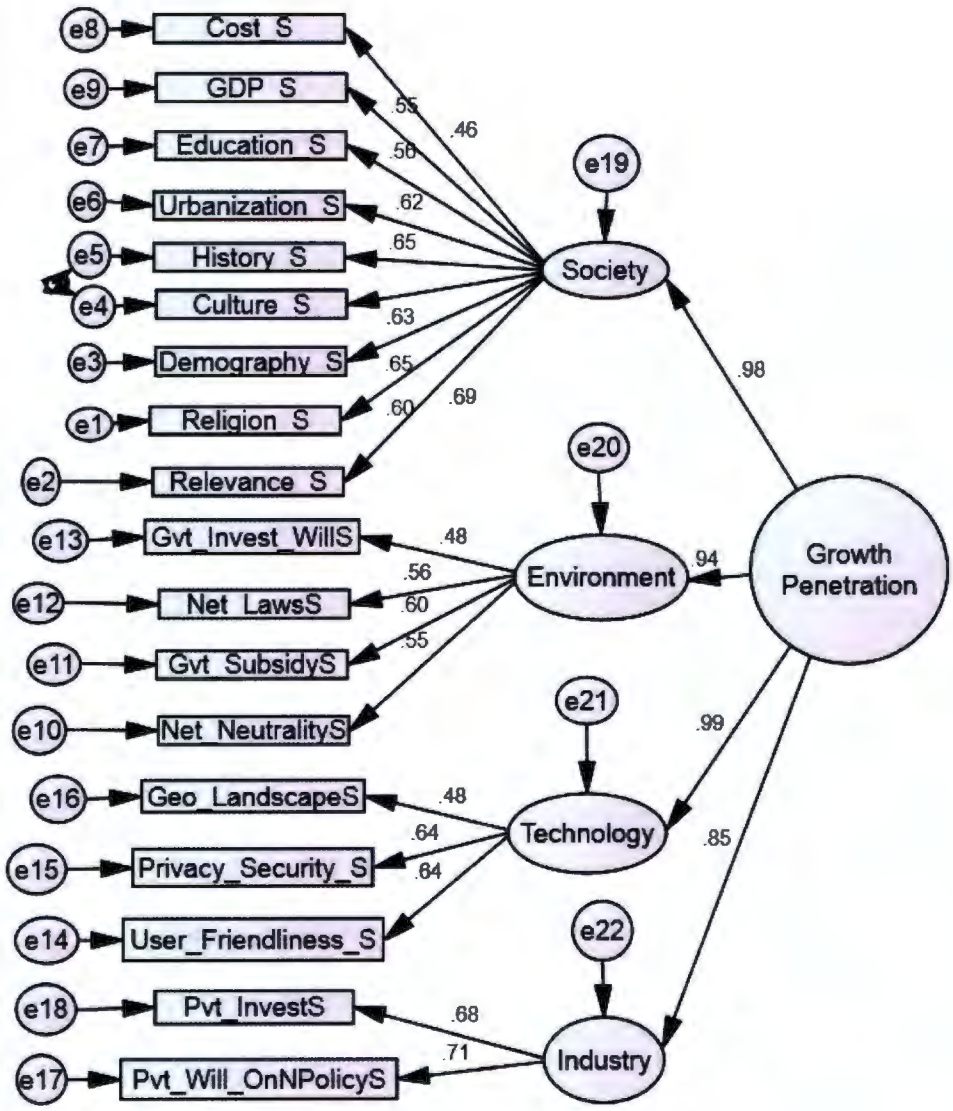
Minimization: .010

Miscellaneous: .533

Bootstrap: .000

Total: .543

Appendix 3 First iteration Modified model



Model Fit Summary

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	41	386.073	130	.000	2.970
Saturated model	171	.000	0		
Independence model	18	3353.570	153	.000	21.919

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	.485	.925	.901	.703
Saturated model	.000	1.000		
Independence model	3.660	.335	.256	.299

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.885	.865	.921	.906	.920
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	.850	.752	.782
Saturated model	.000	.000	.000
Independence model	1.000	.000	.000

NCP

Model	NCP	LO 90	HI 90
Default model	256.073	200.900	318.880
Saturated model	.000	.000	.000
Independence model	3200.570	3015.839	3392.617

FMIN

Model	FMIN	F0	LO 90	HI 90
Default model	.703	.466	.366	.581
Saturated model	.000	.000	.000	.000
Independence model	6.109	5.830	5.493	6.180

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.060	.053	.067	.009
Independence model	.195	.189	.201	.000

AIC

Model	AIC	BCC	BIC	CAIC
Default model	468.073	471.013	644.780	685.780
Saturated model	342.000	354.260	1078.996	1249.996
Independence model	3389.570	3390.861	3467.149	3485.149

ECVI

Model	ECVI	LO 90	HI 90	MECVI
Default model	.853	.752	.967	.858
Saturated model	.623	.623	.623	.645
Independence model	6.174	5.838	6.524	6.176

HOELTER

Model	HOELTER .05	HOELTER .01
Default model	225	243
Independence model	30	33

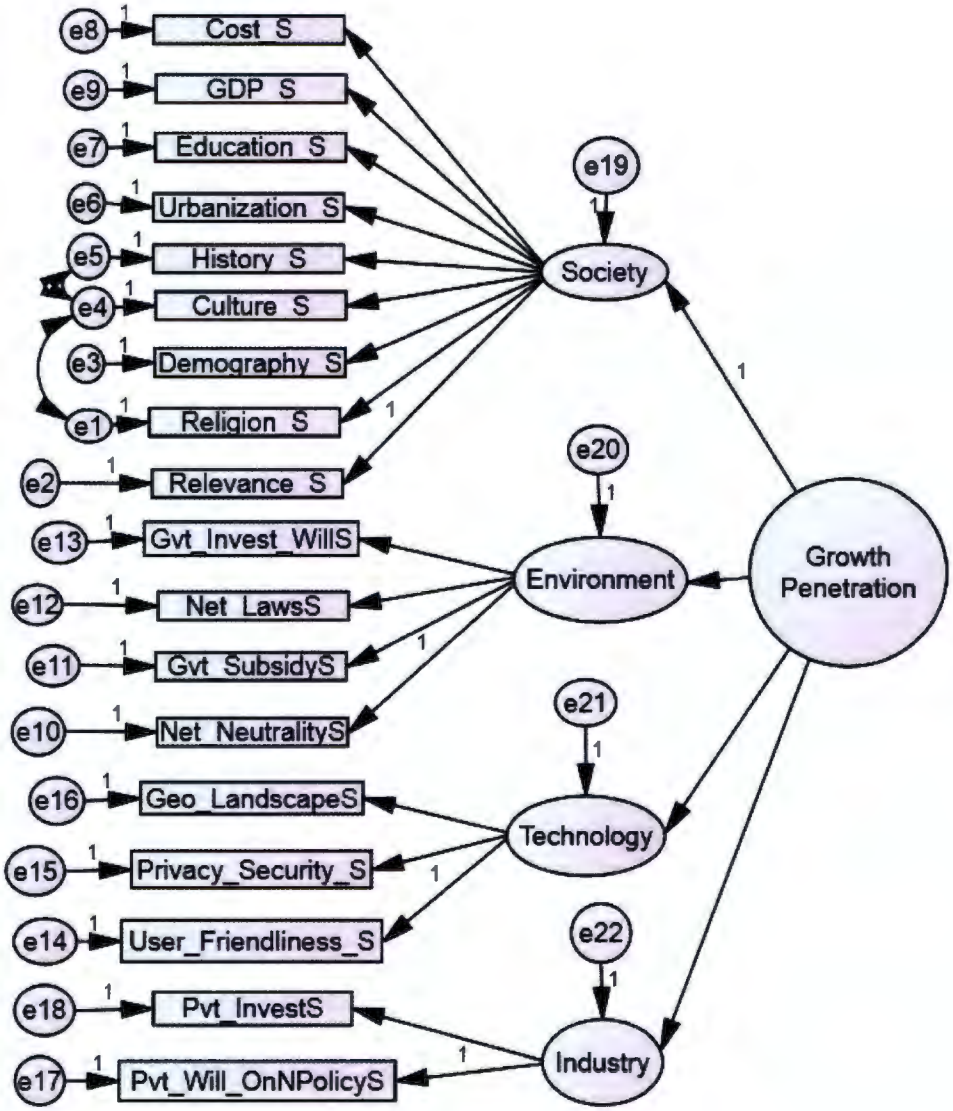
Minimization: .012

Miscellaneous: .468

Bootstrap: .000

Total: .480

Appendix 4 Second iteration Modified Model



Model Fit Summary

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	42	354.977	129	.000	2.752
Saturated model	171	.000	0		
Independence model	18	3353.570	153	.000	21.919

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	.461	.931	.908	.702
Saturated model	.000	1.000		
Independence model	3.660	.335	.256	.299

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.894	.874	.930	.916	.929
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	.843	.754	.784
Saturated model	.000	.000	.000
Independence model	1.000	.000	.000

NCP

Model	NCP	LO 90	HI 90
Default model	225.977	173.694	285.917
Saturated model	.000	.000	.000
Independence model	3200.570	3015.839	3392.617

FMIN

Model	FMIN	F0	LO 90	HI 90
Default model	.647	.412	.316	.521
Saturated model	.000	.000	.000	.000
Independence model	6.109	5.830	5.493	6.180

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.056	.050	.064	.062
Independence model	.195	.189	.201	.000

AIC

Model	AIC	BCC	BIC	CAIC
Default model	438.977	441.989	619.994	661.994
Saturated model	342.000	354.260	1078.996	1249.996
Independence model	3389.570	3390.861	3467.149	3485.149

ECVI

Model	ECVI	LO 90	HI 90	MECVI
Default model	.800	.704	.909	.805
Saturated model	.623	.623	.623	.645
Independence model	6.174	5.838	6.524	6.176

HOELTER

Model	HOELTER .05	HOELTER .01
Default model	243	262
Independence model	30	33

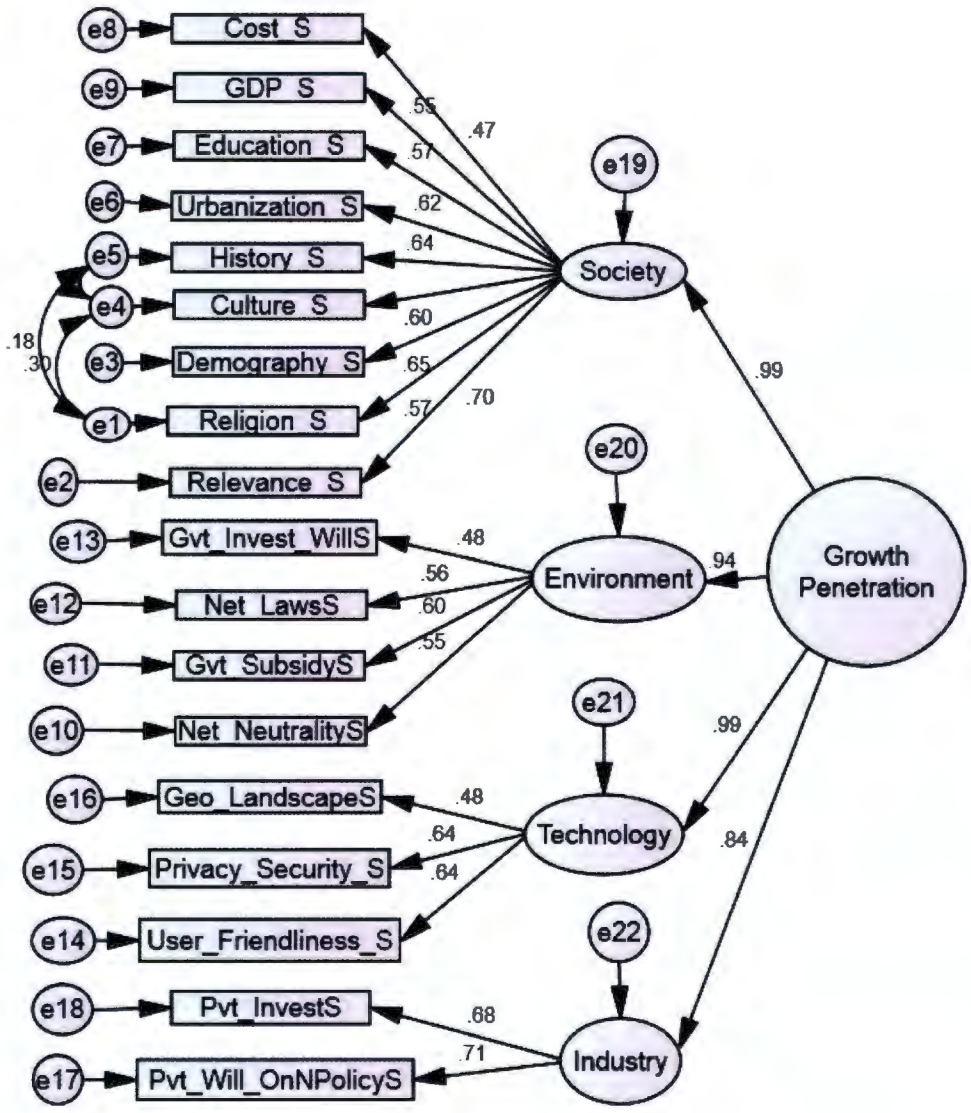
Minimization: .012

Miscellaneous: .460

Bootstrap: .000

Total: .472

Appendix 5 Third iteration Modified Model



Model Fit Summary

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	43	340.014	128	.000	2.656
Saturated model	171	.000	0		
Independence model	18	3353.570	153	.000	21.919

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	.447	.933	.910	.698
Saturated model	.000	1.000		
Independence model	3.660	.335	.256	.299

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.899	.879	.934	.921	.934
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	.837	.752	.781
Saturated model	.000	.000	.000
Independence model	1.000	.000	.000

NCP

Model	NCP	LO 90	HI 90
Default model	212.014	161.148	270.547
Saturated model	.000	.000	.000
Independence model	3200.570	3015.839	3392.617

FMIN

Model	FMIN	F0	LO 90	HI 90
Default model	.619	.386	.294	.493
Saturated model	.000	.000	.000	.000
Independence model	6.109	5.830	5.493	6.180

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.055	.048	.062	.122
Independence model	.195	.189	.201	.000

AIC

Model	AIC	BCC	BIC	CAIC
Default model	426.014	429.097	611.340	654.340
Saturated model	342.000	354.260	1078.996	1249.996
Independence model	3389.570	3390.861	3467.149	3485.149

ECVI

Model	ECVI	LO 90	HI 90	MECVI
Default model	.776	.683	.883	.782
Saturated model	.623	.623	.623	.645
Independence model	6.174	5.838	6.524	6.176

HOELTER

Model	HOELTER .05	HOELTER .01
Default model	251	272
Independence model	30	33

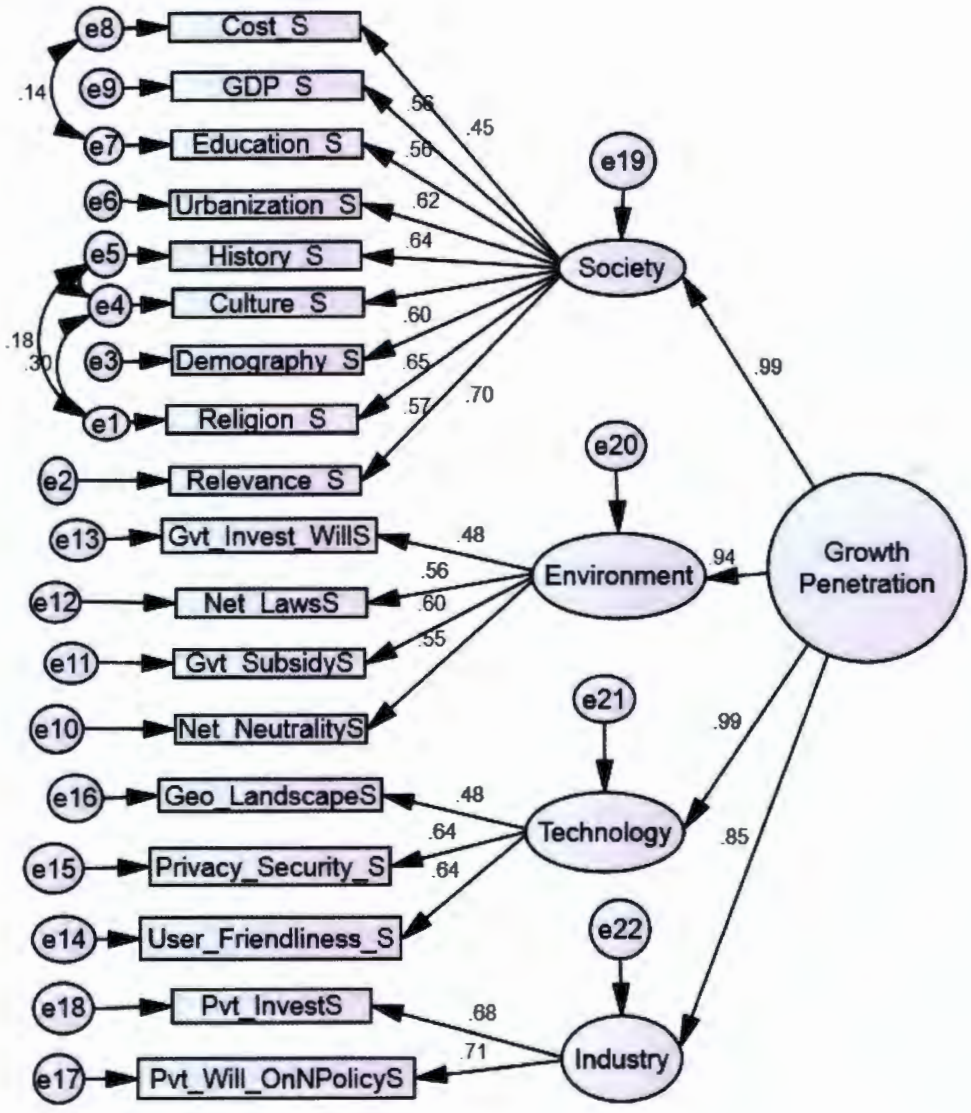
Minimization: .010

Miscellaneous: .485

Bootstrap: .000

Total: .495

Appendix 6 final model fit



Model Fit Summary

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	44	330.026	127	.000	2.599
Saturated model	171	.000	0		
Independence model	18	3353.570	153	.000	21.919

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	.435	.935	.912	.694
Saturated model	.000	1.000		
Independence model	3.660	.335	.256	.299

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.902	.881	.937	.924	.937
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	.830	.748	.777
Saturated model	.000	.000	.000
Independence model	1.000	.000	.000

NCP

Model	NCP	LO 90	HI 90
Default model	203.026	153.112	260.615
Saturated model	.000	.000	.000
Independence model	3200.570	3015.839	3392.617

FMIN

Model	FMIN	F0	LO 90	HI 90
Default model	.601	.370	.279	.475
Saturated model	.000	.000	.000	.000
Independence model	6.109	5.830	5.493	6.180

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.054	.047	.061	.175
Independence model	.195	.189	.201	.000

AIC

Model	AIC	BCC	BIC	CAIC
Default model	418.026	421.181	607.662	651.662
Saturated model	342.000	354.260	1078.996	1249.996
Independence model	3389.570	3390.861	3467.149	3485.149

ECVI

Model	ECVI	LO 90	HI 90	MECVI
Default model	.761	.671	.866	.767
Saturated model	.623	.623	.623	.645

Model	ECVI	LO 90	HI 90	MECVI
Independence model	6.174	5.838	6.524	6.176

HOELTER

Model	HOELTER .05	HOELTER .01
Default model	257	278
Independence model	30	33

Estimates (Group number 1 - Default model)

Scalar Estimates (Group number 1 - Default model)

Maximum Likelihood Estimates

Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
Society	<---	Growth_Penetration	1.000				
Environment	<---	Growth_Penetration	.811	.082	9.871	***	
Technology	<---	Growth_Penetration	1.309	.118	11.107	***	
Industry	<---	Growth_Penetration	.806	.075	10.803	***	
Relevance_S	<---	Society	1.427	.116	12.249	***	
Demography_S	<---	Society	1.264	.108	11.660	***	
Culture_S	<---	Society	1.065	.080	13.296	***	
History_S	<---	Society	1.153	.090	12.747	***	
Urbanization_S	<---	Society	1.269	.112	11.339	***	
Education_S	<---	Society	1.108	.105	10.557	***	
Cost_S	<---	Society	.943	.105	8.965	***	
Net_NeutralityS	<---	Environment	1.000				
Gvt_SubsidyS	<---	Environment	.965	.092	10.503	***	
Net_LawsS	<---	Environment	.922	.093	9.965	***	
Gvt_Invest_WillS	<---	Environment	.756	.084	8.971	***	
User_Friendliness_S	<---	Technology	1.000				
Privacy_Security_S	<---	Technology	.971	.077	12.678	***	
Geo_LandscapeS	<---	Technology	.495	.050	9.813	***	
Pvt_Will_OnNPolicyS	<---	Industry	1.000				
Pvt_InvestS	<---	Industry	1.019	.081	12.518	***	
GDP_S	<---	Society	1.098	.105	10.504	***	
Religion_S	<---	Society	1.000				

Standardised Regression Weights: (Group number 1 - Default model)

			Estimate
Society	<---	Growth_Penetration	.990

			Estimate
Environment	<---	Growth_Penetration	.944
Technology	<---	Growth_Penetration	.987
Industry	<---	Growth_Penetration	.846
Relevance_S	<---	Society	.697
Demography_S	<---	Society	.646
Culture_S	<---	Society	.604
History_S	<---	Society	.637
Urbanization_S	<---	Society	.620
Education_S	<---	Society	.561
Cost_S	<---	Society	.454
Net_NeutralityS	<---	Environment	.554
Gvt_SubsidyS	<---	Environment	.602
Net_LawsS	<---	Environment	.557
Gvt_Invest_WillS	<---	Environment	.482
User_Friendliness_S	<---	Technology	.637
Privacy_Security_S	<---	Technology	.641
Geo_LandscapeS	<---	Technology	.475
Pvt_Will_OnNPolicyS	<---	Industry	.707
Pvt_InvestS	<---	Industry	.676
GDP_S	<---	Society	.556
Religion_S	<---	Society	.568

Covariances: (Group number 1 - Default model)

	Estimate	S.E.	C.R.	P	Label
e1 <--> e4	2.142	.354	6.051	***	
e4 <--> e5	2.885	.361	7.997	***	
e1 <--> e5	1.260	.344	3.659	***	

	Estimate	S.E.	C.R.	P	Label
e7 <--> e8	1.518	.492	3.087	.002	

Correlations: (Group number 1 - Default model)

	Estimate
e1 <--> e4	.295
e4 <--> e5	.413
e1 <--> e5	.175
e7 <--> e8	.141

Variances: (Group number 1 - Default model)

	Estimate	S.E.	C.R.	P	Label
Growth_Penetration	3.495	.519	6.729	***	
e19	.070	.119	.586	.558	
e20	.278	.144	1.932	.053	
e21	.159	.347	.457	.647	
e22	.902	.221	4.076	***	
e1	7.466	.483	15.454	***	
e2	7.660	.528	14.500	***	
e3	7.946	.529	15.019	***	
e4	7.042	.462	15.240	***	
e5	6.942	.463	15.005	***	
e6	9.199	.604	15.224	***	
e7	9.537	.613	15.563	***	
e8	12.212	.764	15.990	***	
e9	9.585	.614	15.610	***	
e10	5.817	.391	14.880	***	
e11	4.210	.295	14.293	***	

	Estimate	S.E.	C.R.	P	Label
e12	4.868	.328	14.850	***	
e13	4.872	.315	15.478	***	
e14	8.986	.647	13.890	***	
e15	8.298	.601	13.813	***	
e16	5.176	.330	15.679	***	
e17	3.173	.287	11.039	***	
e18	3.922	.325	12.076	***	

Appendix 7 BB growth policy ratio

Broadband Growth and Penetration in SADC								
Research has shown that in order to address each of the given factors above, intervention in form of social and business polices is necessary. In your opinion, for each of the factors identified in question 5 above, which type of policies do you think are needed more, social or business? Choose from the following ratios of social to business policies. (1:2 means that for every one social policy we need two business policies and 2:1 means that for every two social policies we need one business policy)								
Answer Options	**1:3**	**3:1**	**1:2**	**2:1**	**1:1**	**Other ratio**	**Rating Average**	**Response Count**
Willingness by government to invest in Information and Communications Technology (ICT).	81	111	126	112	58	6	2.95	494
Geographical landscape of the area in need of internet.	45	99	121	118	54	13	3.17	450
Private investment in ICT.	40	67	131	81	56	6	3.17	381
Internet laws at play in a given country.	31	70	108	102	79	15	3.43	405

Government subsidies in private ICT companies.	34	71	128	88	69	10	3.29	400
Willingness of private ICT companies to uphold national agendas.	37	82	123	99	68	12	3.27	421
Net neutrality (equal access to the internet by all service providers).	48	101	76	87	92	18	3.30	422
Other.	17	12	32	20	26	11	3.50	118
Other (please specify)								3
answered question								**541**
skipped question								**10**

Appendix 8. BB Penetration Policy ratio

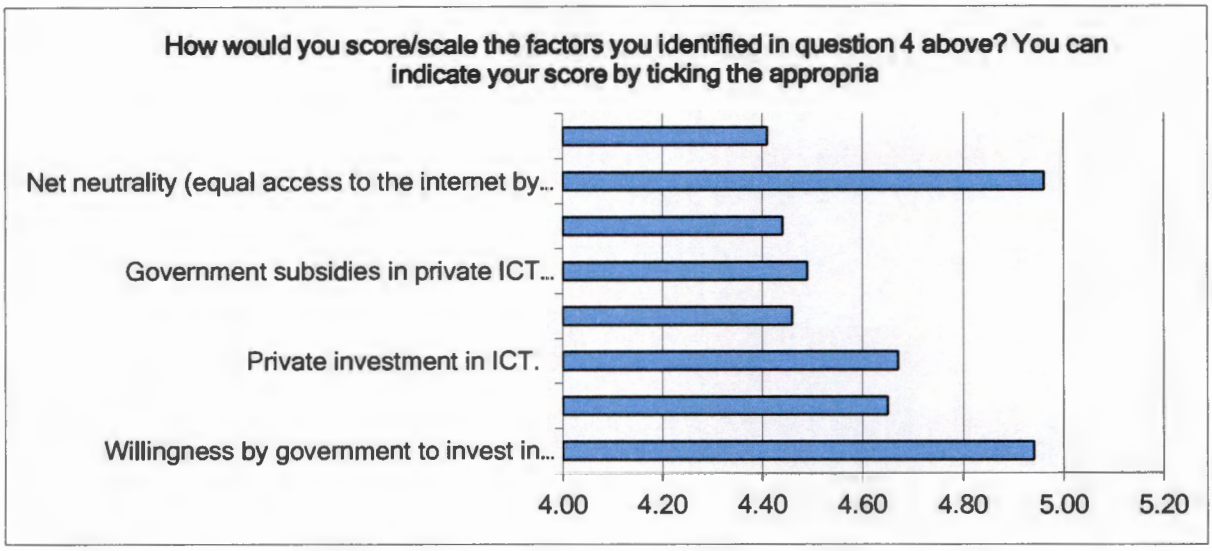
Broadband Growth and Penetration in SADC								
Research has shown that in order to address each of the given factors above, intervention in form of social and business polices is necessary. In your opinion, for each factor identified in question 8 above, which type of policies do you think are needed more, social or business? Choose from the following ratios of social to business policies. (1:2 means that for every one social policy we need two business policies and 2:1 means that for every two social policies we need one business policy and so on)								
Answer Options	**3:1**	**1:3**	**2:1**	**1:2**	**1:1**	**Other ratio**	**Rating Average**	**Response Count**
Gross Domestic Product (GDP) Per Capita of a country.	86	100	101	75	52	9	2.84	423
Cost of using the internet.	71	76	144	90	63	14	3.09	458
Level of education of the people expected to be using the internet.	83	72	124	100	59	10	3.02	448
Urbanization of the society.	57	54	109	113	58	15	3.26	406
History of the people expected to be using the internet.	47	45	120	79	75	12	3.33	378

Culture of the people expected to be using the internet.	52	61	98	82	81	14	3.31	388
Demography of the internet users.	50	60	120	92	64	11	3.23	397
Privacy and security concerns of using the internet.	37	88	91	112	61	14	3.28	403
Relevance of services and content found on internet.	46	69	107	94	62	9	3.22	387
User friendliness of the internet.	59	71	98	96	70	19	3.25	413
Religious beliefs.	44	45	84	63	84	23	3.49	343
Other.	13	16	28	21	16	14	3.49	108
Other (please specify)								3
answered question								**536**
skipped question								**15**

Appendix 9. BB Growth and penetration factors ranking

Broadband Growth and Penetration in SADC										
How would you score/scale the factors you identified in question 4 above? You can indicate your score by ticking the appropriate radio button for each factor. Note: ticking the first button means a score of 1, the second, a score of 2 and so on. The highest influencing factor/s can only have a maximum of 8 scores, i.e last button ticked. Different factors can have the same score.										
Answer Options	**1 score**	**2 scores**	**3 scores**	**4 scores**	**5 scores**	**6 scores**	**7 scores**	**8 scores**	**Rating Average**	**Response Count**
Willingness by government to invest in Information and Communications Technology (ICT).	32	35	61	98	64	67	48	87	4.94	492
Geographical landscape of the area in need of internet.	21	53	69	86	71	53	29	67	4.65	449
Private investment in ICT.	15	37	68	64	70	47	43	37	4.67	381
Internet laws at play in a given country.	33	41	61	83	54	42	43	39	4.46	396

Government subsidies in private ICT companies.	23	34	68	82	69	59	26	33	4.49	394
Willingness of private ICT companies to uphold national agendas.	25	44	60	89	74	48	48	22	4.44	410
Net neutrality (equal access to the internet by all service providers).	26	42	50	66	56	39	48	81	4.96	408
Other	20	14	14	28	21	14	13	18	4.41	142
Other (please specify)										7
answered question										**548**
skipped question										**3**

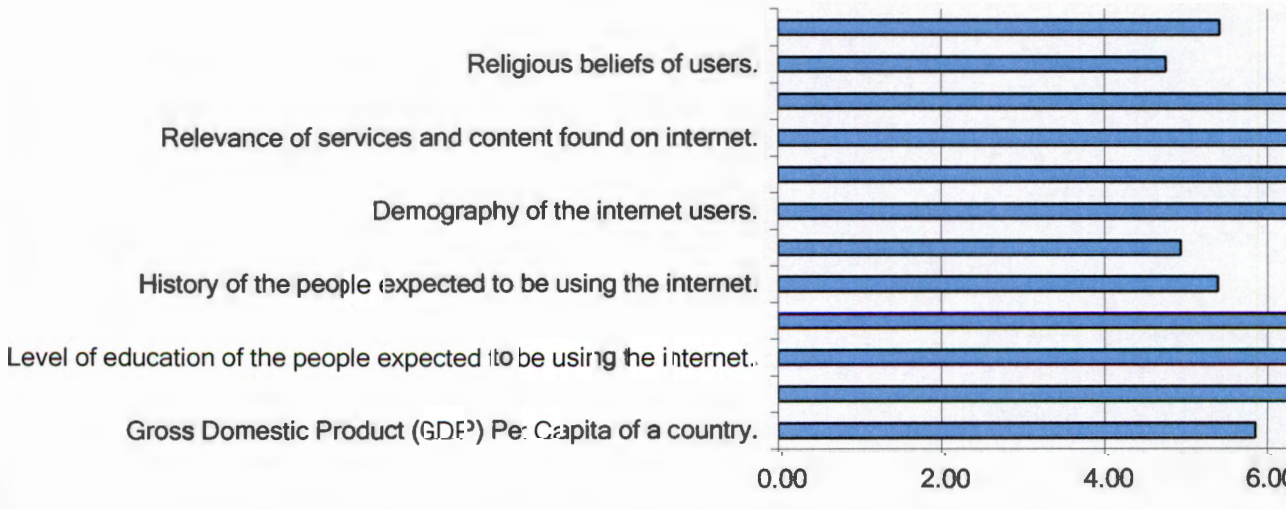


Appendix 10 BB Penetration Factors' ranking

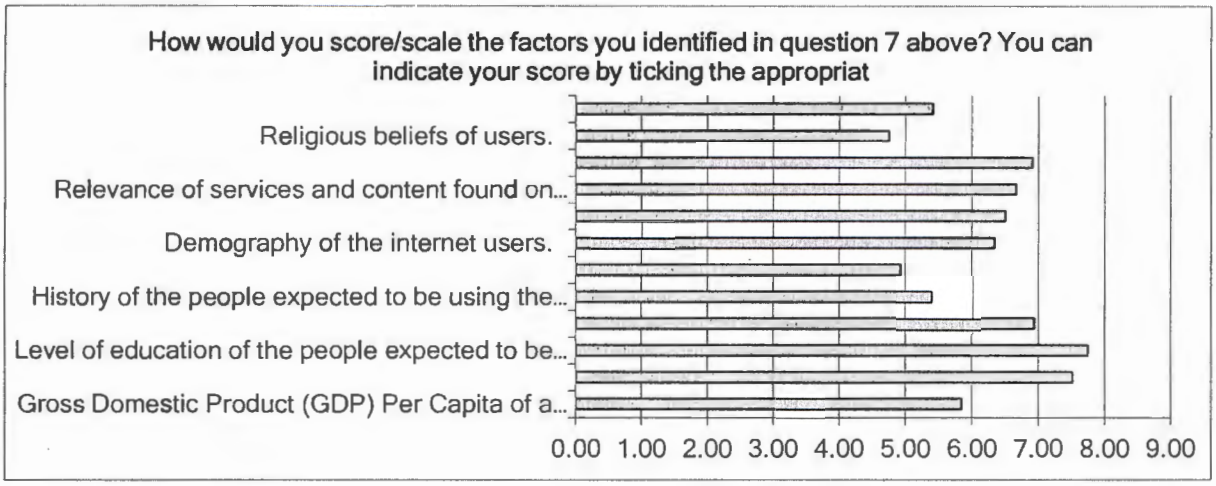
Broadband Growth and Penetration in SADC													
How would you score/scale the factors you identified in question 7 above? You can indicate your score by ticking the appropriate radio button for each factor. Note: ticking the first button means a score of 1, the second, a score of 2 and so on. The highest influencing factor/s can only have a maximum of 11 scores, i.e last button ticked. Different factors can have the same score.													
Answer Options	**1 score**	**2 scores**	**3 scores**	**4 scores**	**5 scores**	**6 scores**	**7 scores**	**8 scores**	**9 scores**	**10 scores**	**11 scores**	**Rating Average**	**Response Count**
Gross Domestic	**37**	**34**	**59**	**45**	**41**	**30**	**36**	**42**	**25**	**26**	**53**	**5.85**	**428**

Product (GDP) Per Capita of a country.													
Cost of using the internet.	**13**	**16**	**29**	**33**	**47**	**45**	**23**	**50**	**34**	**56**	**117**	**7.52**	**463**
Level of education of the people expected to be using the internet.	**8**	**12**	**29**	**36**	**39**	**29**	**46**	**46**	**60**	**64**	**110**	**7.75**	**479**
Urbanization of the society.	**5**	**21**	**34**	**40**	**43**	**46**	**29**	**46**	**48**	**56**	**47**	**6.94**	**415**
History of the people expected	**32**	**39**	**43**	**45**	**57**	**43**	**36**	**30**	**23**	**19**	**23**	**5.39**	**390**

How would you score/scale the factors you identified in question 7 above? You can indicate your s the appropriat



Demography of the internet users.	**16**	**20**	**31**	**53**	**46**	**67**	**29**	**42**	**26**	**33**	**44**	**6.34**	**407**
Privacy and security concerns of using the internet.	**12**	**32**	**30**	**47**	**44**	**40**	**45**	**40**	**44**	**43**	**39**	**6.50**	**416**
Relevance of services and content found on internet.	**15**	**26**	**32**	**35**	**40**	**40**	**43**	**43**	**48**	**37**	**47**	**6.67**	**406**
User friendliness of the internet.	**15**	**18**	**35**	**43**	**38**	**44**	**44**	**33**	**45**	**49**	**65**	**6.91**	**429**
Religious beliefs of users.	**63**	**49**	**39**	**37**	**42**	**27**	**28**	**32**	**18**	**14**	**17**	**4.75**	**366**
Other.	**13**	**10**	**10**	**8**	**11**	**9**	**13**	**7**	**4**	**5**	**9**	**5.41**	**99**
Other (please specify)													**4**
answered question													**545**
skipped question													**6**


How would you score/scale the factors you identified in question 7 above? You can indicate your score by ticking the appropriat
Religious beliefs of users.
Relevance of services and content found on...
Demography of the internet users.
History of the people expected to be using the...
Level of education of the people expected to be...
Gross Domestic Product (GDP) Per Capita of a...
0.00 1.00 2.00 3.00 4.00 5.00 6.00 7.00 8.00 9.00