ACCESS COVERAGE FOR REMOTE CONNECTIVITY FRAMEWORK (ACRCF):

FACILITATING SCHOLARSHIP AWARDING IN NAMIBIA

A THESIS SUBMITTED IN PARTIAL FULFILMENT

OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF SCIENCE IN INFORMATION TECHNOLOGY

OF

THE UNIVERSITY OF NAMIBIA

BY

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OCTOBER 2015

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ABSTRACT

The corporate world was faced with the challenge of community development. As a result, Namibian companies have been offering scholarships to assist students as best as they can. It was however an insurmountable task to assist the populace without clarity of information or background knowledge. Consequently, the selection of students for scholarships was arguably questionable.

Some students awarded scholarships were from rural areas and others from urban areas. However, notice had to be taken of those students in remote area schools where connectivity was lacking. In this age of growing technology, solutions to the dilemma of leaving out worthy students for scholarships should be available with the use of Long Term Evolution (LTE) technologies. The LTE powered technologies would provide seamless interlinking of remote students to the scholarship providers.

LTE technologies based on the Access Coverage Remote Connectivity Framework (ACRCF) proposed in this study would deal with the high quality content requirements. The technology would provide a feasible service for the provision of improved interview sessions between students and sponsor selection panels. The interview panels would not have to request students to travel long distances to the interview venues, hence saving travel costs and time by ensuring students are interviewed economically. Interviews would be able to

take place over Voice over Internet Protocol (VoiP) and other interfaces under the ACRCF infrastructure.

The sponsors would be able to access student information readily at their fingertips through the providence of high quality presented student data on a website maintained under the ACRCF infrastructure. Terminals would be placed at the various remote schools to ensure that student data was updated and ready for use as required. These nodes at the various remote schools would hence be updated with all the student records at the specific remote schools to ensure that there was up-to-date data on the systems at the click of a button.

A qualitative research approach was undertaken for the purposes of the study to explore the derivations from case studies. Interviews were held with various sponsors and students to confirm the current state of affairs. They were also held to establish the need for the ACRCF infrastructure to link sponsors to the remote students to improve the scholarship selection process.

A quantitative research approach was used in the form of questionnaires handed out to various sponsoring institutions for sampling purposes. The data was analysed with use of the SPSS statistical software program. The findings indicated that selections for scholarships had a need to be improved in the area of equitability. Equitable selection would provide equal opportunities for all students whether in resource rich town centres, rural or remote areas.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS

ACRCFM: Access Coverage for Remote Connectivity Framework Model

ACRCF: Access Coverage for Remote Connectivity Framework

CaaS: Cloud as a Service

DDCM: Digital Divided Conceptual Model

GSM: Global System for Mobile Communications

ICT: Information and Communication Technology

IP: Internet Protocol

ISP: Internet Service Provider

IT: Information Technology

ITU: International Telecommunications Union

LTE: Long Term Evolution

MICT: Ministry of Information and Communications Technology

MOE: Ministry of Education

MTC: Mobile Telecommunications Ltd

NSFAF: Namibian Students Financial Assistance Fund

TCP: Transmission Control Protocol

TN: Telecom Namibia

UDP: User Datagram Protocol

UNAM: University of Namibia

UNESCO: United Nations Educational, Scientific and Cultural Organization

VoIP: Voice over Internet Protocol

WiMAX: Worldwide Interoperability for Microwave Access

ACKNOWLEDGEMENTS

The author would hereby like to acknowledge firstly God Almighty, for His great love, kindness and blessings throughout life culminating to the completion of this work. I would like to thank, with sincere gratitude, my supervisor, Professor Jameson Mbale for his great patience and guidance in this work. I would like to thank Professor Mbale for not giving up on me and for showing me that there was light at the end of the tunnel. I would like to thank the Professor for assisting me to be focused on the right path in the struggle to complete this work. I would like to sincerely thank Professor L. Press for obliging to review this work from his busy schedule. Thank you.

I acknowledge my fellow colleagues, with sincere gratitude, for their reviews: Madam Valerie Garises, Mr. Tomas Kamukwema, Ms. Jambeko Uudhila, Ms. Lilian Siboleka, Mrs. Nalina Suresh and Mr. Semba Funda.

I would like to thank Ms. Revonia Kahivere (Old Mutual) for her kindness in allowing me an interview with her and providing me with valuable information for the research. I would like to thank Mr. Dillon Musvamirhi for his kindness in offering me time to be interviewed. I would like to thank Mr. John Ekongo (MTC) for offering me time to be interviewed as well as assisting me with data collection of the questionnaires handed out. I would like to thank Mrs. Alanda Xoagus (Telecom Namibia) for giving me time from her busy schedule for an

interview. I would also like to say a special thank you to Mr. Samuel Duncan for availing himself to provide me time from his busy schedule for an interview.

I would also like to thank Ms. Erika Di Maulo, Ms. Florence Dushimemaria and Ms. Maria Ntinda for assisting with further review of this work.

DEDICATION

To the Lord, God Almighty, to my mother, Hilma Konstantin, to my sister, Iyaloo Ndiwakalunga, to my father, Tomas Ndiwakalunga, to my Church family who prayed for me and encouraged me in this work.

DECLARATION

I, Immanuel Ombili-Tuna Ndiwakalunga, declare hereby that this study titled: "Access Coverage Remote Connectivity Framework (ACRCF): Facilitating Scholarship Awarding in Namibia" is a true reflection of my own research, and that this work, or part thereof has not been submitted for a degree in any other institution of higher education.

……. Date…….

Mr. Immanuel Ombili-Tuna Ndiwakalunga

1. INTRODUCTION

This chapter outlines the research by providing the statement of the problem, the research questions, the significance of the study, the limitations of the study and definitions to terms. The chapter concludes with an outline of the structure of the thesis.

1.1 Background

Connectivity provision through efficient access coverage to all corners of a nation was essential in ensuring equitable selection of students for scholarships. Connectivity could be ”rather loosely defined by referring either to the extent to which sites wishing to connect to the network are actually equipped with a network connection, or to the extent to which sites are still able to contact other network sites in the event of a component failure” (Oxford Dictionary of Computing, 2004).

Access coverage refers to the geographical connectivity provision. Geographically, Namibia is a vast, sparsely populated country with a land mass of eight hundred and twenty-three thousand two hundred and ninety (823,290) square kilometres with a small population of two million one hundred and ninety-eight thousand four hundred and six (2,198,406) people that have needed to adapt to the rapid changes of the twenty-first century, which includes access to Internet (CIA World Factbook, 2012).

According to the researcher's observation, the Namibian people in isolated remote areas were sometimes left out and have not been benefitting from the advantages of network coverage. In this case, accessibility by potential scholarship donors for students in remote schools was hampered. Whitacre and Mills (2010) noted that persistent geographical disparities in access coverage remained a source of concern for rural communities. They further noted that this 'digital divide' could exacerbate existing inequalities in economy between the rural and urban areas. In the researcher's view, this 'digital divide' has caused a marginalisation of people in rural areas of Namibia. There was therefore a need to investigate how the provision of infrastructure could impact people in the remote areas.

Through this research, Long Term Evolution (LTE) could be used to provide the missing connection to address the issue of inequitable connectivity to the remote regions. The emphasis was especially at educational centres for the benefit of Namibian remote students. This work would ensure improved reach for these students through use of the connectivity technology to improve the economy of those remote areas (please note: in this work, remote area was used interchangeably with rural area).

This work proposes Access Coverage for Remote Connectivity Framework which is abbreviated as ACRCF. The framework would be setup in conjunction with various schools and sponsors in order to provide an equitable standard for involved donors to reach remote communities in Namibia. It would be set for the

developments in the deployment and use of Information and Communication Technologies (ICTs) to be on par with national objectives in terms of bridging communication barriers.

For equitability, ACRCF technologies would benefit students in selection for sponsorships from designated Namibian high schools by sponsors. It would be structured to allow an all-inclusive LTE network coverage for seamlessness in applications to assist the selection process. The seamlessness would be ensured through the ACRCF speed to assure that data was readily available to all stakeholders when needed.

Mwangi et al. (2011) said that a platform for sharing and exchange of information provides a good opportunity for growth and development due to increased access to resources. They added that it mitigates the geographical hurdle and other related socio-cultural and cost challenges. In agreement with the authors, a virtual platform for student selection for scholarships would be indeed a good opportunity for growth and development of those students due to improved access to information via the LTE technologies. The LTE virtual platforms would enhance interview-scenario communications. Indeed sponsors would not have to pay for the students to travel long distances from their remote villages to the interview locations. Hence, the ACRCF would ensure improved socio-cultural communications for the students and their sponsors from remote area.

Borgman (2007) claimed that scholars in all fields are taking advantage of the wealth of online information, tools, and services to ask new questions, create new kinds of scholarly products, and reach new audiences. She advocated that the Internet lies at the core of an advanced scholarly information infrastructure to facilitate distributed data and information intensive collaborations. In support of Borgman, this research asserts that the Internet improves communications. It was important to notice the value of information, the tools, services and audiences that the technology allows its users to reach. In terms of the ACRCF, information was of paramount importance to be distributed at the doorsteps of the scholars.

The ACRCF was a platform to allow the rural students to benefit from the world of online information, and in this case, scholarship information. The Internet had been an important tool for information exchange that cannot be undermined. Reaching remote avenues was arguably easier with the Internet as it allows different communities to connect through the use of collaborative technology such as LTE infrastructures. Henceforth, the introduction of the ACRCF would bring about a link between the rural and urban areas in terms of scholarly high school centres in the Namibian jurisdiction for improved access coverage to these communities. It would also bridge the digital divide in terms of scholarship information using the LTE technologies.

Furthermore, the ACRCF was a network infrastructure based on the 4G LTE technologies that are used in the Namibian market by the two main

communications companies, namely: Telecom Namibia (TN) and Mobile Telecommunications Ltd (MTC). The infrastructure would focus on the facilitation of connectivity between remote students and sponsorship donors. The framework would further create the needed connectivity that would fulfil the promise of connectivity to the poor rural areas in Namibia. Hence, it would contribute to the improvement of the social, economic as well as cultural context of the remote areas in tandem with growth in national ICT services towards vision 2030.

1.2 Statement of the problem

The equitable selection of students for scholarships was an area of concern as learners in rural areas are left out due to lack of connectivity. Khene et al. (2011) observed that rural development had become a significant focus for developing countries as the poverty that existed in the world today has been predominantly rural. Similarly, Namibia would be no exception to such challenges which have been affecting the students in the remote communities as a result of limited coverage.

Press (2004) said that Internet connectivity was nearly non–existent in the rural areas of developing nations, and far below that of developed nations in the urban areas of developing nations. In support of Press, poor or non-existent connectivity was evident in Namibian remote areas. As a result, it was bringing about a rift in

the equitability of the selection of Namibian students from remote areas as opposed to those in urban areas in the scholarship selection process.

Barrett and Slavova (2011) indicated that in developing countries, infrastructure, appliances, and services influence the delivery of affordable ICTs. They observed that wired telecommunications infrastructure tend to reach rural areas in the wake of complementary rural access infrastructure such as roads and electricity and the expansion of public services such as education. In support of Barrett and Slavova's statement, Namibia's rural areas have poor infrastructures for connectivity in order to link students to sponsors. In this study, the ACRCF addresses the remote coverage problem with the use of Long Term Evolution (LTE) technologies.

According to the World Bank (2006), inequality of opportunity, both within and among nations, sustains extreme deprivation, results in wasted human potential and often weakens prospects for overall prosperity and economic growth. In agreement to the report, unequal opportunities are evident in respect to connectivity, whereby it was prominent in Namibian urban areas as opposed to the remote which results in the deprivation of students from rural schools being marginalised from equal opportunities to sponsorships. Hence, national development was bound to suffer through the waste of talented potential scholarship recipients.

Henceforth, this study aimed to address the inequalities that existed between the rural and urban area students in terms of scholarship awarding. The implementation of the ACRCF would improve the link between Namibian sponsors to remote students to ensure that equitable selection was realised.

1.3 Research questions

The study aimed to answer the following questions:

1.3.1 How can access to connectivity in remote schools be improved to facilitate equitable scholarship awarding amongst learners in Namibia?

1.3.1.1 What can LTE connectivity contribute towards the improvement of communication between sponsors and remote schools?

1.3.1.2 What measures can be used to promote fairness in scholarship awarding amongst remote and urban area students?

1.4 Objectives of the study

The research objectives of the study were to propose a framework (ACRCF) that utilised LTE technologies in order to provide connectivity between remote students and sponsors in urban areas for equitable student selection.

1.5 Significance of the Study

This research would help meet the need for unbiased scholarship selection processes with the help of readily available data provided as a result of the utilisation of LTE powered applications. The applications would be used to cater for large data amounts and for multiple inputs and outputs required in the selection process. Furthermore, it would allow the data to be readily accessible through the use of LTE connectivity technologies. This study would contribute to the provision of a more efficient standardised system of selection for both government and non-governmental entities in the selection of candidates for scholarships and grants for further study at institutions of higher learning. It would provide a more equitable selection process as the connectivity link was established with the remote areas to bring about improved fairness in selection.

1.6 Limitation of the study

The research would be limited by the willingness of various stakeholders to participate in the implementation of the ACRCF. Stakeholder participation includes political will as there would be need for a requirements analysis that would need to be met before infrastructure was set in place or was approved. The availability of respondents to provide the much needed data for the study was a constraint.

1.7 Research Methodology

The study utilised both qualitative and quantitative methods, in terms of questionnaires and interviews. Descriptive statistics was used to analyse scholarships awarding and connectivity between rural and urban area students. Furthermore, correlation analysis looked into the connectivity patterns whilst regression analysis determined the effects of the relationship between scholarship awarding and connectivity between the rural and urban areas.

1.8 Main Contribution of the study

The main contribution of the study was to highlight the deepening distance between the urban students and remote ones in terms of access to scholarships. The study proposed the ACRCF frame that provided an outline on bridging the gap between remote schools to the respective sponsors. The ACRCF proved viable in improving communications in the Namibian setting by providing the respective users with a solution in connecting the chasm between the urban and remote communities.

The research highlighted the variations in distribution of communications infrastructure. For instance, the main power utility, Nampower, declared that most of its electrification infrastructure, which was necessary for communications equipment, was based in the urban areas. Moreover, the telecommunications providers, MTC and Telecom Namibia, stated that their infrastructures such as base stations were mainly stationed in urban areas.

1.9 Definitions of Terms

Access Coverage: in this thesis refers to access to information networks which constitute the essential tool for enabling citizens to participate in the economic, political, and social life of their communities; and, as such, forms the basis for participatory democracy (Kvansny et al, 2006).

Bandwidth: is the measure of the information-carrying capacity of the channel, usually the range of frequencies passed by the channel (Oxford Dictionary of Computing, 2004).

Base station: a transmission and reception station in a fixed location, consisting of one or more receive/transmit antenna, microwave dish, and electronic circuitry, used to handle cellular traffic (Canadian Radio-television and Telecommunication Commission, 2014).

Connectivity: It is the state of platforms, systems or applications in a network being connected or interconnected rather loosely defined by referring either to the extent to which sites wishing to connect to the network are actually equipped with a network connection, or to the extent to which sites are still able to contact other network sites in the event of a component failure (Oxford Dictionary of Computing, 2004).

Internet Service Provider (ISP): a business or other organisation that provides Internet access to others, typically for a fee (Morley and Parker, 2007).

Long Term Evolution (LTE): is a standard for wireless communication of high-speed data for mobile phones and data terminals. LTE is a fourth generation (4G) mobile communications standard (Ericsson, 2014).

1.10 Outline of the Thesis

Chapter 1: This chapter provided a background of study, research questions, limitations of study, significance of study, definitions of terms, and summary of the Thesis.

Chapter 2: This chapter provided insight into the various technologies used for connectivity in comparison with LTE technologies. It also reviews the role of global connectivity as well as local connectivity within the Namibian context with respect to dealing with rural and urban communities. It reviews previous methods of scholarship selection with comparison to the ACRCF scholarship awarding process.

Chapter 3: This chapter presented the research methodology and confirms the methods deployed, procedures undertaken on how the study was carried out.

Chapter 4: This chapter presented the results and findings of the study in tabular, graphical and numerical form. It further presented the findings of the research, their implications and the impending effects of the ACRCF as a result of the outcomes.

Chapter 5: This chapter delineated the ACRCF as well as depicting the ACRCFM and the DDCM with explanations.

Chapter 6: This chapter presented the conclusion and amalgamates the entire Thesis, highlighting the essence and importance of the study undertaken and the achievements of the study as well as recommendations for further research.

2. LITERATURE REVIEW

This chapter presents the different works on connectivity between the rural and urban communities in the developed and developing worlds. It also addresses the various technologies used for connectivity in comparison with LTE. The chapter reviews the role of connectivity within the Namibian context with respect to rural and urban inequalities in scholarship awarding to facilitate enhanced selection.

2.1 Connectivity in the Developed Versus Developing World

Connectivity was a world-wide phenomenon as more of the world was linking up to information sources through Internet infrastructures for improved services and communications. Habib and Mazzenga (2010) acknowledged that rural broadband access was not limited to Europe but represented a common global challenge, which includes Africa. In view of Habib and Mazzenga, it was well-known that access coverage was not available to all communities. Similarly, not all societies have Internet access in Namibia, and especially the remote under-privileged areas.

World Youth Report (2003) identified that statistics on the digital divide showed an increasingly polarised world. The report further emphasised that the Internet was the most central technology in the global media culture, examining its use and provided some understanding of the proportions of the overall ICT differences and an opportunity to assess the significance of ICT for young people on a global scale. In view of the report, it was unfortunate that the world was polarised between the developed and underdeveloped nations, especially with

respect to lack of Internet access to the remote areas. In support of the report, the Internet was indeed central in global media communications. In the Namibian context, the digital divide in terms of connectivity to rural areas simply deprived the students from remote area with updated information compared to the urban ones.

According to Measuring the Information Society [MIS] Report (2013), the Republic of Korea led the world in terms of overall ICT development for the third consecutive year, followed closely by Sweden, Iceland, Denmark, Finland and Norway. The abovementioned industrialised countries are benefiting from the ICT infrastructure across their populations. In terms of ICT development, the ACRCF initiative has been intended to benefit the Namibian society in terms of connectivity provision through LTE services to improve leverage with the developed world.

The MIS report continued that the Netherlands, Luxembourg and Hong Kong were ranked in the top ten (10), with the United Kingdom (UK) following the top ten (10) groups from eleventh (11^{th}) position since 2012. These are all advanced nations that are undoubtedly ahead in terms of information and communication technology services such as connectivity to their rural communities. These countries are developed because of their advanced connectivity services that encourage improved collaboration, efficient information processing and service delivery.

According to Shammo (2013), more than fifty-four percent (54%) of LTE subscriptions in mid-2013 were in the United States of America (USA) alone. Moreover, IDATE (2014) stated that the total LTE revenue in 2013 was estimated at fifty-seven (57) billion euros. Further, the IDATE Report highlighted that video represented close to sixty percent (60%) of LTE traffic. It also indicated that LTE-Advanced was launched in the second half of 2013 in South Korea. The deployment of connectivity technologies is surely high in developed countries as depicted by the numbers. The ACRCF was a connectivity initiative that would be focused on connecting more of the Namibian populace in terms of students to scholarship sponsors. The more the youth connect to useful information services in the country through frameworks like the ACRCF, the faster the country can achieve its development goals.

The International Telecommunications Union (2014) indicated that almost three (3) billion people, which equated to forty percent (40%) of the world's population were using the Internet. Further, forty-four percent (44%) of households had Internet access, yet in Africa only one (1) out of ten (10) households was connected. Based on the above, it was evident that Africa, which includes Namibia, was behind the rest of the world in terms of technology advances. The ACRCF would be a positive initiative to build up confidence in improved infrastructure for this developing African country. The ACRCF initiative would help in the improvement of connectivity as students, whether they have Internet at home or not, would be able to access information at respective schools portals.

Rena (2008) stated that poor Internet connectivity was one of the pertinent issues in the digital divide between developing and industrialized countries hampering the transition to the global information society. The author added that African countries needed good and inexpensive Internet services, to become "information societies" in their search for more favourable social and economic conditions. She declared that collaboration between societal institutes such as schools should have been encouraged at regional and international levels. She further indicated that the collaboration between stakeholders was essential both for the connection to the global Internet, and for the formation of a regional communication infrastructure. She concluded that governments should apply their legislative authorities to enforce "low price/ high connectivity" business models to encourage competitiveness, as to prevent monopolistic telecommunication markets. In support of Rena, government plays a critical role in the implementation of ICT infrastructure frameworks such as the ACRCF. The legislative authorities would need to work on making such technological developments less painstaking for the stakeholder initiatives such as the ACRCF. Flexible legislation towards ICT deployments, in this respect, the ACRCF, would enhance the impartial development process of the nation.

A study by Tsatsou et al (2011) showed that connectivity was regarded of high importance in the developed world. It was the same case in Namibia that connectivity was of importance to connect the nation for development to occur in communication infrastructure and to enhance people's lives. The ACRCF would

use LTE for Internet to be accessed by the remote areas in an innovative manner to allow the sponsors in communicating better with rural students.

Niang et al. (2013) noted that the difference in the use of services could be attributed to a lack of access to those resources among rural populations. They provided a case of the district of Samtse in Bhutan where there were seventeen (17) village clusters, among which Lamjee was the most remote. They further mentioned that there were no roads to Lamjee and people had to walk six (6) hours from the village just to reach the nearest farm road. The authors continued that from there it took another two (2) hours to walk four (4) kilometers to the Municipal center of Hathkhola where few vehicles travelled that road, and a taxi would cost about nine dollars (US$9.00) round-trip. In agreement with the authors, it was a costly experience to travel from the rural to the urban areas. In Namibia it was difficult for the students to be travelling all the way to Windhoek or other town centres from their remote distant areas for interview appointments with sponsors.

The dismal results in Bhutan on rural areas being neglected from useful services are not unique. A similar situation in access to bursary applications was faced by many remote areas and especially in developing countries, which includes Namibia. Application frameworks such as ACRCF are required to bridge the gap between the urban and rural societies as well as to facilitate services and products tailor-made for the benefit of remote communities, and in this case: rural students.

The situation of travelling to Lamjee, a remote village was Bhutan, was no exception at all, as the remote areas in Namibia are usually further away from civilized urbanization and infrastructure. The way of life was much more difficult for the rural residents as they have to travel long distances for proper services such as health, postal services and even access to information such as scholarships. The ACRCF would assist Namibian rural students to receive information at their convenience through use of LTE technologies. The ACRCF would assist in keeping them informed about scholarship information and to receive information about sponsors readily.

The International Telecommunications Union (2014) projected that by the end of 2014 only twenty percent (20%) of the population in Africa would be online compared to seventy-five percent (75%) in Europe. The report further stated that the analysis of access to all information and communications technology services, from mobile telephony to broadband, reveals that there remains a substantial urban and rural access gap, with considerable disparities in levels of access between urban and rural communities. Namibia, an African country, was faced with connectivity issues in remote regions. The need to implement a system to assist with bridging the connectivity gap between the rural and urban areas was clearly evident in order to move Namibia towards developed status. The ACRCF would contribute to narrowing the digital divide between the rural and urban locations in the country.

The Universal Access and Service Policy for ICTs (2012) stated that in the year 2011, only forty-six percent (46%) of Namibians aged fifteen (15) and upwards living in rural areas had a mobile phone, compared to seventy-seven percent (77%) of Namibians in urban areas. Further, only three percent (3%) of rural households had a fixed line phone, compared to twenty-six percent (26%) of urban households. In reference to the Ministry of Information and Communications Technology's Universal Access and Service Policy, the ACRCF would be able to assist with levelling the communications field in terms of the urban and rural services reach.

The Policy continued that with respect to broadcasting services, the picture was similar, with ownership of a working radio and television set reported by only sixty-six percent (66%) and nineteen percent (19%) respectively of rural households, compared to eighty-one percent (81%) and seventy-three percent (73%) of their urban counterparts. It concluded that only two percent (2%) of rural households had Internet access, compared to twenty-seven percent (27%) of urban households. The report added that this reflects an urban-rural divide in respect of access to ICTs, which was related to other urban-rural disparities. The report also said that only twenty-two percent (22%) of rural households had electricity - which was a key support infrastructure, enabling rollout of telecommunications, broadcasting, Internet and broadband networks - compared to eighty-two percent (82%) of urban households. ACRCF was a framework that was meant to contribute to an improved linkage between sponsors and students.

The deployment of the ACRCF would contribute to improving Namibian statistics on growth in communications and services to the nation as more schools would be connected to Internet. Information stored in the framework's cloud service database would provide easier retrieval. The framework would contribute to efforts of growing the country moving from underprivileged status of developing to developed as the nation receives attention through improved communications between schools and sponsors.

Furthermore, UNDESA (2013) declared that Namibia as a country had one hundred twenty-seven thousand and five hundred (127500) Internet users by the year 2010, and a population of two million three hundred and twenty-four thousand (2 324 000) people by 2011. The Department stated that Windhoek (Namibia's capital city) had three hundred and eighty thousand (380000) people in the year 2011. It further indicated that of these people, mostly in Windhoek, there were four (4) users per hundred (100) inhabitants using the Internet in 2005, with the figure increasing to eleven point six (11.6) in 2010. The Report further stated that in 2011 that figure increased to twelve (12.0) inhabitants per hundred (100) users using the Internet.

In support of the report, the statistics provided were an indication of the growing need for connectivity services such as Internet for improved flow of information. The statistics stated were somewhat dismal as the threshold has still been nowhere near fifty percent (50%) of the hundred (100) inhabitants using Internet around

the country. The low percentage provided was focused mainly on urban areas where most of the connectivity infrastructure has been stationed. More needed to be done in bringing infrastructure to the rural domain in order to reap benefits in information flow and fairness practices, in this case scholarship selection or awarding, hence the ACRCF.

Furthermore, the Department projected that urban population growth in Namibia between 2010 and 2015 was expected to grow by three point one percent (3.1%) while growth in rural regions was only expected at zero point seven percent (0.7%). This disparity in the urban and rural movements was an indication of the whereabouts of the inhabitants. In support of the report, people were migrating to places with infrastructure and resources, hence the need to provide infrastructure such as ACRCF to the rural sector. The ACRCF would contribute to even growth rate in both areas to prevent talented human capital from leaving the deprived remote region as people envision the growth in rural communities through such framework.

According to D. Musvamirhi, (personal communication, April 20, 2014), a telecommunications engineer at Mobile Telecommunications Ltd. (MTC), connectivity was possible only within the coverage area, but could increase with installations of car kits. In contrast to Musvamirhi, the ACRCF's focus would be at remote schools and would have the antenna installations at the respective schools to ensure constant connectivity.

2.2 Connectivity in Remote Areas

Simba et al. (2011) have noted that rural areas especially those of the developing countries provide challenging environments to implement communication infrastructure for data and Internet based services. They claimed that the main challenges were the high cost of network implementation and lack of customer base, as rural areas were characterized by low income, highly scattered and low population densities. Additionally, they stated that the situation drives network operators to establish network infrastructures in urban centres leaving rural areas as underserved communities. As for Namibia, ACRCF would improve the missing connectivity to the rural areas and especially the schools in these underprivileged areas. Nonetheless, whether the connectivity companies make immediate returns or not, the provision of connectivity to the remote areas would be a positive in the long run as the students from remote areas are assisted and they are able to plough back the knowledge resulting from their education.

Brewer (2005) indicated that in practice, connectivity just to schools and key public spaces covered a tiny fraction of a rural area, and was thus significantly cheaper to deploy. The author said the downside of targeted connectivity was harder to use and therefore less impactful than full coverage, but given the cost difference, which was more than an order of magnitude, it seemed better to start with limited coverage and expand it as the economy grew. On the contrary, focused connectivity supplied by the ACRCF would be useful to all students from remote area due to its application in free accessible scholarship information at

school terminals and the application process that affords rural students an equal opportunity to send their information to sponsors in good time. Through the ACRCF stakeholder scheme, funding for the connectivity would be enabled to reduce costs to an individual sponsor.

According to UNESCO Broadband Commission Report (2013) as technology entered the lives of many people for the first time, innovation and the rate of technological change has accelerated. Further, the report stated that models of open innovation, partners, customers, researchers and even competitors found new ways to collaborate, with firms using external, as well as internal ideas and paths to market to advance technology. Similarly with ACRCF it becomes easier when sponsors network and collaborate even on issues such as scholarships by the use of a collaborative infrastructure rather than working individually and covering unnecessary costs or not reaching the full audience of students intended for assistance. Further, in support of the report it was imperative that Namibia adapt to the changes of a fast changing world in order to keep up with developments and to be able to compete at a global standard with the rest of the world. ACRCF would enable growth as the development on needy students would impact the economy of the country in the long run for the better.

Habib and Mazzenga (2010) specified that due to costs of radio coverage and trunking, the quality of services provided by existing commercial mobile systems was low in densely populated areas. They stated that in rural areas the quality of

services provided was well below that offered by operators in urban and sub-urban areas. They concluded that current solutions for rural areas such as providing basic telephone services were rarely suitable for effective data access. Ofcom Communications Market Report (2012) stated that many young people agreed that new communications services had made life easier – seventy-two percent (72%) of sixteen to twenty-four (16-24) year olds and seventy-three percent (73%) of twenty-five to thirty-four (25-34) year olds. In view of the above, it was an unfortunate situation that the remote areas were left out of communication services when there was such a wealth of knowledge and benefits to be received through such service.

ACRCF would contribute to ensuring the gap in service for connectivity to remote schools for the improved selection of students would be met. It was as the UNESCO Report confirmed that ICT infrastructure had moved on from instruction operation to the integration of ICTs and the Internet integrated into the fabric of the environment surrounding us- invisible, embedded, exchanging data and information, constantly and automatically. The consolidation of various ICT infrastructures have played a vital part in today's community developments. The processes of data flow would need interoperability provision for efficient human technology interactions for best services under the ACRCF.

2.3 Long Term Evolution (LTE) for Connectivity

The right communications technologies would be essential in providing connectivity services efficiently in remote areas. Deployment costs, technology comparisons, and relevant factors on the best method to implement the ACRCF would need to be considered. According to the author's observation, LTE was mostly compared to World Interoperability for Microwave Access (WiMAX) as the two most advanced communications technologies. Similarly, another connectivity technology compared to LTE was HSDPA+ (High Speed Downlink Packet Access Plus).

According to D. Musvamirhi (personal communication, April 20, 2014), the speed rates between 3G (WiMAX, HSDPA+) and 4G (LTE) were remarkably different. He said 3G had a speed of about twenty-one (21) Megabits per second (Mbps) while 4G had speeds of up to one hundred (100) Megabits per second (Mbps). The ACRCF would take advantage of the high speeds of LTE to provide information to both students and the sponsors in a faster and improved form.

Speed was not the only element that LTE would contribute to the ACRCF. Brewer (2005) established that the mechanism of targeted coverage was the use of directional antennas. The author discovered that a typical "24 dBi" antenna, which costed about 80 dollars (US$80) in India, enabled a five (5)-degree beam that was amplified (using no power) by a factor of about two hundred and fifty (250). He said that enabled hot spots of coverage with megabits of bandwidth that

were more than thirty (30) km from the tower. He stated that those kinds of antennas were orthogonal to the particular wireless technology, and had been used in Bangladesh for non-mobile village phones. The ACRCF would use directional antennas in the form of boosters to enlarge the volume of waves reflected by the LTE base stations.

According to Deloitte (2012), LTE capital expenditure for a tier one operator in the first year of deployment was anywhere from a few hundred million dollars to billions of dollars, depending on existing infrastructure, population density, targeted area to be covered and spectrum available. Additionally, for some operators the most powerful rationale for upgrading to LTE would be to free up 3G capacity for voice. They concluded that when data migrates to LTE, the decongestion of 3G networks would mean higher quality voice services. Similarly, the higher voice and video quality was one of the reasons the ACRCF employed LTE technology. Voice over Internet Protocol (VoIP) services such as through Skype technologies would be deployed and performed even more meritoriously as User Datagram Protocol (UDP) would thrive on the faster LTE networks.

Frenzel (2009) stipulated that WiMAX was primarily a data service. He said the best way to think of WiMAX was as a super-long-range version of Wi-Fi (Wireless Fidelity). In addition, he stated that it was not as fast as LTE, even if it had a range of many kilometres. He affirmed that WiMAX data rates depended on

the bandwidth, the modulation and typically run from about one (1) to two (2) Megabits per second (Mbps) in common consumer installations. In addition, he said that maximum data rate was about seventy-five (75) Mbps under maximum bandwidth. He also declared that the range extended from one (1) to eight (8) kilometres depending on placement and number of base stations. It was notable that the author conceded that LTE was faster than WiMAX. By and large, LTE was the better technology. The ACRCF was to use LTE technologies to provide services and seamless selection of students from the remote areas to assist in the development of those parts.

In contrast to Frenzel (2009), Place et al. (2012) had conveyed that most significantly, 4G LTE offered a higher bandwidth – increasing the speed of data transfer, a lower latency – providing faster response times from the network, an improved spectrum efficiency – which increased overall network capacity. They further said that the architecture and efficiency of LTE also made it a more cost-effective network to run. In addition they said Quality of Service (QoS) management capabilities mean that certain applications could be given particular network performance characteristics, provided a more consistent high-quality user experience. The ACRCF used LTE to provide a better user experience as the sponsors and remote students communicated via VoIP service at terminals that were connected through the infrastructure. The use of improved connectivity services would undoubtedly improve the threshold of student selection by sponsors.

Kurose and Ross (2010) declared that WiMAX supported mobility speeds of about one hundred and twelve to one hundred and twenty-eight (112-128) kilometres per hour (km/h). Namibia was mostly employing WiMAX technology, yet there was the faster and more effectual LTE which was the preferred choice of technology for the ACRCF to ensure efficiency to reach the rural schools.

According to Sengar et al. (2011), LTE had been placed as the next generation mobile wireless telecommunication technology which provided an improved path to Fourth Generation (4G) from Third Generation (3G). Furthermore, they said LTE offered peak data rates of hundred (100) Mbps for downlinks (DLs), fifty (50) Mbps for uplink (UL) channels and also support one point four to twenty (1.4-20) Mega Hertz (MHz) scalable bandwidth. Moreover, they acknowledged that it provided low-cost and low-complexity workstations in support of global exploited. In view of the above, low cost and complexity were crucial entities in any infrastructure. However quality of service was not to be underestimated. In support of the authors, the ACRCF took into consideration the cost, complexity, and quality of service delivered through the use of LTE technologies which proved useful in communications world over.

Additionally, they said that LTE could support up to five hundred (500) km/h of mobility speed. They also stated that LTE provided network operators high network throughput, improved path from 3G networks, low latency, plug and play architecture, an all-IP packet based network, and low operating costs. In view of

the authors, LTE technology was certainly the choice technology for the seamless communication between the remote areas in Namibia and the various sponsors in the country for equitable student selection for scholarships.

According to UNESCO broadband commission report (2013), LTE Advanced alone accounted for five hundred (500) million subscriptions by 2018. Correspondingly the report citing Pyramid (2013) projected that globally, 4G LTE subscriptions were expected to grow tenfold over five years, from eighty-eight (88) million in 2012 to eight hundred and sixty-four (864) million in 2017. The report stated that such connectivity, combined with low-cost but advanced devices, provided unprecedented opportunities to empower individuals across society.

Seamless connectivity provision by LTE powered ACRCF would only improve the information flow as well as enable interactions between the rural and urban environments in a building and fairness appealing approach. The report noted that while tremendous benefits were realised in key areas such as education, healthcare and commerce, more needed to be done. The arrival of the Western African Cable System to Namibia has provided increased capacity for LTE deployments across the country to provide connectivity services that were faster and beneficial to the nation. The LTE nodes would provide even better services than the 3G the nation had been using and provided assurance for the viability base requirements for the setup of the ACRCF.

Mbale (2011) proposed the use of Long Term Evolution-Rural Wireless Architecture Model (LTE-RWAM) to be installed with multiples of sophisticated equipment to manage and carry the signals covering a very large geographical area at a low cost. He said this kind of system was developed to suit the rural environments which cannot afford expensive telecommunication infrastructure. In the Namibian context, the LTE-RWAM could be implemented via the ACRCF in the provision of school focused connectivity in the rural areas with the various sponsors. Use of sensors in the ACRCF would ensure that the sites were always up due to a synchronous system that reports or detected when the connectivity at any school was down or up.

It was notable that Long Term Evolution technology via the ACRCF would be able to deal with the high quality content requirements as well as provide a feasible service in the provision of interview selections. The interview panels would not have to request students to travel long distances to the interview centres, hence saving costs to ensure more students were interviewed economically for all parties involved. Interviews would be able to take place via a Voice over Internet Protocol (VoIP) solution provided by the ACRCF structure. The ACRCF would ensure that the connectivity would focus on ensuring that students in the remote areas were equally recognised as those in urban areas. Hence the placement of base stations would consider areas of priority such as schools in those remote districts.

2.4 Long Term Evolution and the Cloud

The world was geared towards the cloud, it was imperative that new technologies such as LTE were linked to the cloud in order to provide improved services that benefited the user communities. The ITU (2014) stated that African countries would capitalize on ITU-T cloud computing standards as they developed their broadband networks and increase Internet access speeds. They further stated that Africa employed a futuristic view of telecommunications, with Governments' ICT strategies emphasizing the value of cloud computing to young people in Africa and the need to foster skill development in this domain. They said the growth of the cloud ecosystem was also expected to result in immediate benefits to the African ICT industry, with local vendors enjoying new business in their supply of solutions to support cloud services.

The use of LTE technologies could only be enhanced by linking up with the cloud to provide information access that was available to users in various locations of the Namibian geographical map. The speed of LTE was essential for cloud services to work more productively for the users as the cloud could be accessed from any location including by use of mobile devices.

The ACRCF would simply encourage collaboration amongst the stakeholders since it would make use of cloud services supported by the LTE backhaul infrastructure and at the same time would allow various telecommunications stakeholders that were providing scholarships to cooperate rather than act as

separate entities in the development of Namibian youth. The cloud service in the infrastructure would allow for a centralised environment where the sponsors would be able to access data about students and also in the provision of information about scholarships.

2.5 Scholarship Applications

The University of New South Wales (2014) of Australia detailed that it offered two thousand (2000) students each year a scholarship. They stated that some of the areas they offered scholarships in were: academic merit, sporting ability, rural and indigenous students, relocating scholars, those with disabilities, equity and faculty scholarships.

The UNSW (2014) further noted that their scholarship application process was through any portal to their online system. They stated that the online system provided information on scholarships to students. For rural students, they said that the prerequisite was to have been enrolled in a rural school for four years. Additionally, the rural areas would have to be considered according to the Commonwealth's Accessibility/Remoteness Index of Australia (ARIA) and the Rural Remote and Metropolitan Areas (RRMA) classification. In view of the University of New South Wales (UNSW) application process, it was clear that it did not focus on having a framework with the provision of portals at remote schools as the ACRCF would. There was also a difference between Australia and

Namibia in terms of development of connectivity services to the rural areas. Hence, the ACRCF was purposely suited for the Namibian setting.

The University of Indiana Report (2013), the institution had an online scholarship awarding and selection process access via diverse computer systems. Further, the report emphasized that fiscal reporting often occurred long after the awarding period. They noted that ramifications were exceptional students were not receiving scholarships for which they were eligible. They distinguished that some exceptional students did not attend or remain at the university due to the lack of scholarship funding. Moreover, they stated that some donated funding was improperly utilized or goes unutilized. The other impact they discovered was that the data was not available for proper reporting, so further decisions about student usage or financial impacts were not possible. In addition, they said they were currently developing a unified system that would process all varieties of scholarships for students on all Indiana University campuses. They stressed that with the completion of each phase of their project, administrators would be able to award and manage scholarships with greater ease from one central system. Furthermore, they confirmed that they believed they would be able to award scholarships to more students. The University of Indiana was in the industrialised world, where the best technologies such as LTE infrastructure were used. The ACRCF considered the solutions in those developed world countries in order to provide a resolution for the Namibian context in terms of scholarship applications and awarding.

Similar to the University of Indiana's scholarship awarding framework, the ACRCF would provide a centralised service for the sponsors to be able to award scholarships in an easy and equitable manner, which would encourage more Namibian rural students to apply for scholarships. The sponsors would be able to access student information readily at their fingertips through ACRCF.

3. METHODOLOGY

The purpose of this chapter is to explain the methodologies used in the research with respects to research design, population, population sample, and research instruments. The chapter concludes with a summary.

3.1 Research Design

The design of the research consisted of the qualitative method involving interviews for the personnel at Telecommunications companies for information on connectivity and sponsored students. The quantitative method involving questionnaires for the participants to fill was used to ensure a strong data validation for the purpose of the study.

3.2 Population

Personnel and students from selected Namibian high schools were targeted to participate in quantitative research by answering questionnaires. Public and private institutions that were serving out bursaries and scholarships were also targeted to ensure a strong validation for the purpose of the research. Randomly, students from remote and urban areas were also chosen to participate in the study. Specialists in the fields related to the technologies relevant in the deployment of the ACRCF and potential stakeholders were interviewed.

3.3 Sample

The total sample size was one hundred and forty-seven (147) consisting of seven (7) interview participants from amongst the sponsors as well as one hundred and

forty (140) questionnaire participants from the Namibian education sector and its stakeholders. A total of four (4) schools were sampled as well as six (6) potential sponsors. Forty (40) respondents were derived from two (2) Namibian remote schools, namely: Ambili Combined School, in Oshana region, and also Oshitudha Combined School, in Omusati region, in the far remote north. Another forty (40) respondents were selected from two (2) urban schools, in the Windhoek region, namely: Academia High School, in Pionerspark, and Windhoek High School. Each of the four (4) schools had twenty (20) participants who filled-in the questionnaires.

Samples were also derived from six (6) companies, namely: First National Bank (FNB), Mobile Telecommunications Ltd (MTC), Telecom Namibia, Namibian Students Financial Assistance Fund (NSFAF), Old Mutual, and the Bank of Namibia (BoN). Ten (10) participants from each of the companies were ideally required to participate in answering the questionnaires. However, the results showed varied responses as denoted in the next chapter. Two (2) private companies and four (4) parastatals, potential sponsors, took part in this study to provide a total population sample of sixty (60) ideal participants from the sponsoring fraternity. Former bursary recipients as well as personnel dealing with scholarship awarding were also sampled through qualitative approach. Random sampling was employed to ensure a more accurate representation.

3.4 Research Instruments

The main questionnaires were of three sections, namely: Section A, Section B, and Section C. Each section had its various purposes such as demographics, awareness, opinions and perceptions on the selection of learners particularly those from remote areas. Structured interviews were conducted on an individual communication basis to ensure worthwhile data comparisons.

3.5 Procedure

Initial piloting questionnaires were handed out by the researcher at Telecom Namibia. The questionnaires handed out at Telecom Namibia provided an indication of the best questions that would be required by the final questionnaire. After the questionnaire piloting process a piloting interview was also done at Mobile Telecommunications Ltd (MTC).

Questionnaires were drafted, printed, and handed out at the various targets, which included FNB, MTC, Telecom Namibia, NSFAF, Old Mutual, schools and the BoN. Interviews were also conducted with personnel from Telecommunications providers, MTC and Telecom Namibia to answer the questions on connectivity reach to rural areas and to substantiate the need for LTE technologies in these areas. Data collected was analysed and presented in various forms for clarity of information presented.

3.6 Data analysis

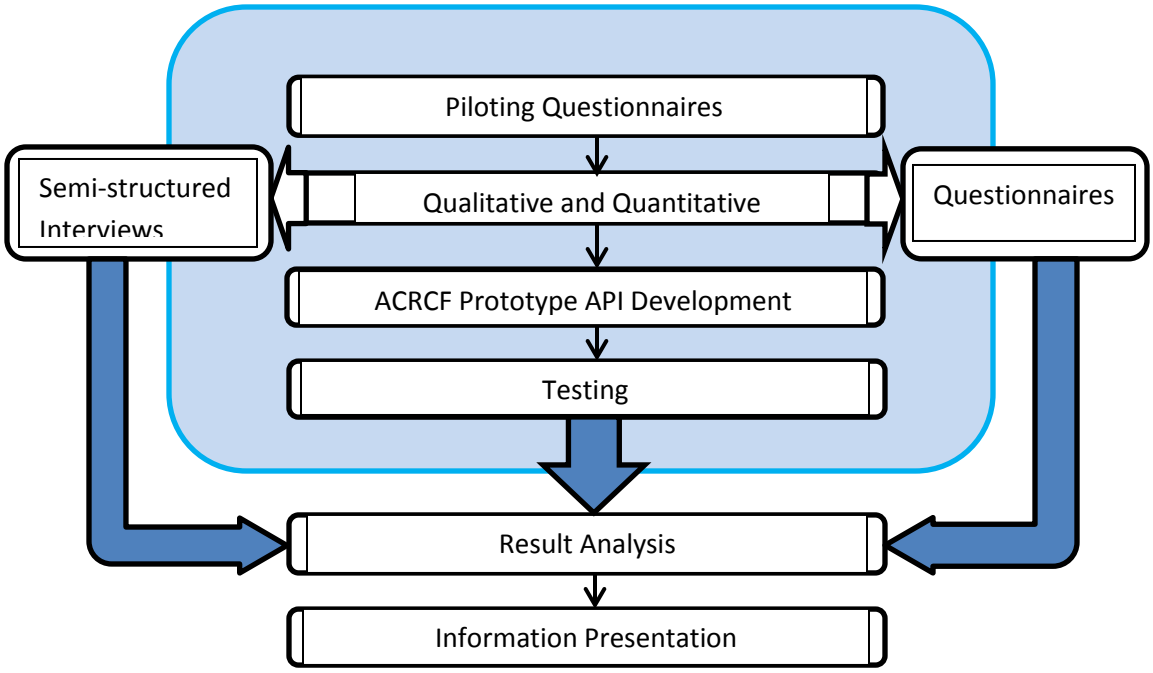

Figure 3.1: *Access Coverage for Remote Connectivity Framework Data Analysis*

Figure 3.1 described the data analysis process and the ACRCF information from qualitative and quantitative methodologies. The data was modelled by use of graphs, charts, and descriptive statistics formulae for the purposes of the study. IBM SPSS version 21 software was used for capturing and processing the collected data. Microsoft Excel was used to generate graphs and charts.

3.7 ACRCF Prototype API Methodology

The researcher designed a prototype Application Programming Interface (API) for the ACRCF terminals at the schools (see APPENDIX G). The API design was

intended to analyse the interactions of the remote students with the sponsors through the use of LTE connectivity backbone provided by ISP. The methodology followed in the design of the API was depicted as below:

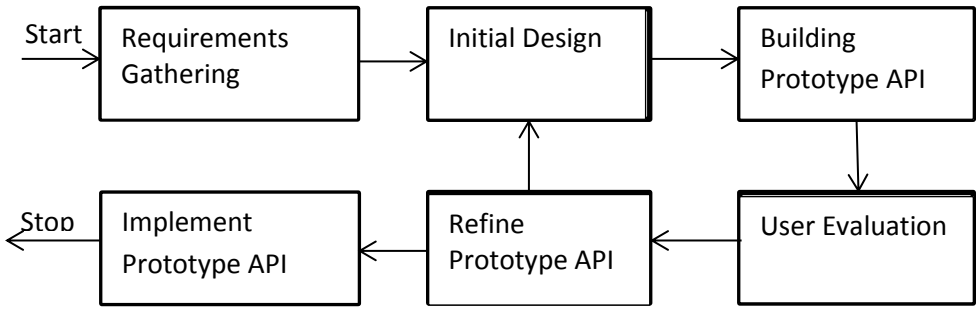

Figure 3.2: *Prototype for API Design of ACRCF*

The above prototype API design methodology describes the steps followed in the building of the interface. Requirements Gathering was essential to arrive the usability of such an interface between the students and sponsors. Initial Design then followed according to the requirements gathered. The production of the API began and User Evaluation step be entered as to how the system would be used by the sponsors as well as the students at the remote schools. The Prototype was then refined after User Evaluation before the cycle continued reaching to finalisation of the API as depicted in APPENDIX G.

3.8 Research Ethics

Permission was sought from relevant authorities in order to ensure data was collected in an ethical manner. Relevant respondents were assured of anonymity

and confidentiality. No respondent was asked to give their name or be disclosed to have contributed to the research without their prior consent.

3.9 In Summary

The methodology used employed the application of Figure 3.1 layouts for the research. The models considered ethical standards and design of the study for population sampling and research instrument testing procedures. Data findings from the methodologies were presented as discussed in the next chapter.

4. DATA ANALYSIS, RESULTS AND DISCUSSION

This chapter presents the data collected through qualitative and quantitative methodologies. The data analysis utilises charts, graphs, tables and statistical tests to derive the information presented. Demographic structure information derived from data is presented in the first section of the chapter. It is followed by the detailed analysis of the data before deductions and findings are denoted from the data. Moreover, the data findings are further discussed in depth.

4.1 Data Analysis and Results

Data was clustered into three (3) sections according to questionnaire, interview feedback, and inferential statistics. In terms of demographics, the data collected was taken from a total population of one hundred and forty-seven (147) respondents, of which fifty-eight (58) were male and eighty-nine (89) were female. The participant data count translated into thirty-nine percent (39.5%) of males and sixty percent (60.5%) of females from sponsors and schools.

The targeted sample had been 140 participants for questionnaires and 7 for interviews. Hence the data collection from the prospected targets was achieved. A deeper look into the population determined how the data was collected from the participants and which respondents provided more or less information, or missing values. The total population percentages of male and females were depicted in Figure 4.1.

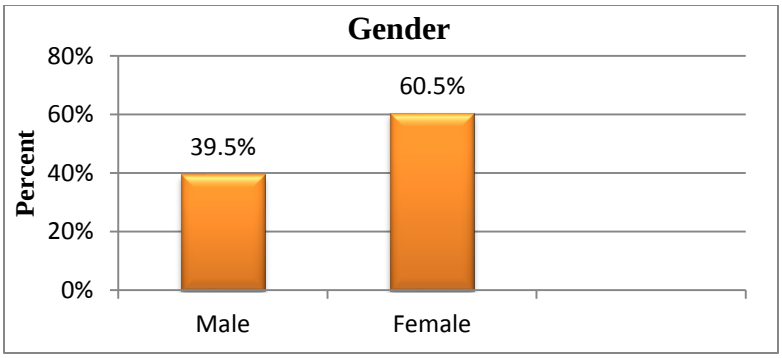

Figure 4.1: Total respondent population according to Gender

It is observable, according to Figure 4.1, that the majority of respondents in the study were females (60.5%).

4.1.1 Questionnaire Feedback Analysis

Information from data collected through questionnaires was grouped into two, namely:

4.1.1.1 Sponsors (Parastatals/Ministry/Private companies)

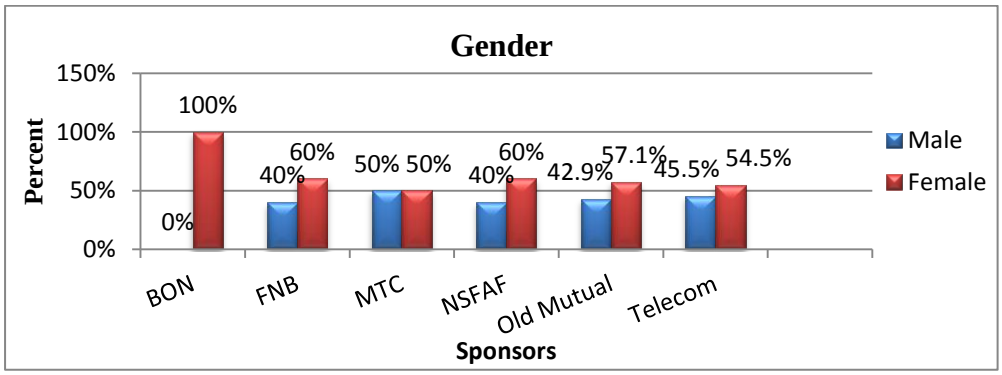

Figure 4.2: Sponsor Respondents according to Gender

From Figure 4.2 it was observed that the majority of the sponsor respondents were female. The respondents from Mobile Telecommunications Ltd (MTC) were even at 50/50 representation of three (3) males and females respectively. Bank of Namibia (BoN) had a representation of zero (0) males compared to one (1) female at hundred percent (100%). First National Bank (FNB) had a representation of four (4) males at forty percent (40%) compared to six (6) females at sixty percent (60%).

Namibian Students Financial Assistance Fund (NSFAF) had a representation of four (4) males at forty percent (40%) compared to six (6) females at sixty percent (60%). Old Mutual had a representation of three (3) males at forty-two point nine percent (42.9%) compared to four (4) females at fifty-seven point one percent (57.1%). Telecom Namibia had a representation of five (5) males at forty-five point five percent (45.5%) compared to six (6) females at fifty-four point five percent (54.5%).

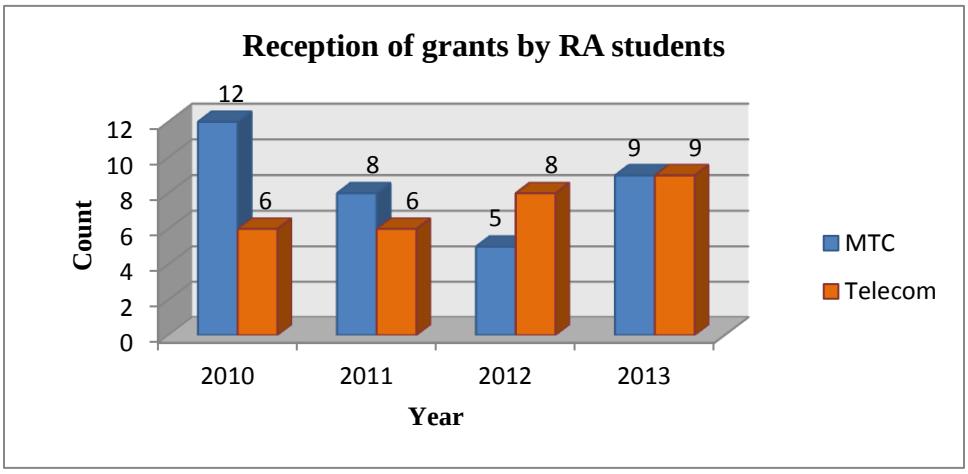

Figure 4.3: Number of rural area students receiving grants from Sponsors

According to Figure 4.3, the number of students that received grants from MTC in 2010 to 2013 was thirty-four (34). 2010 was the year with most scholarships granted to twelve (12), 2011 with eight (8), 2012 with five (5), and 2013 with nine (9) students receiving grants.

Figure 4.3 further depicted that respondents from Telecom claimed that the sponsored students from rural areas were six (6) in the years 2010 and 2011 respectively. Three (3) respondents asserted that in 2012 the students were eight (8). In 2013, the respondents provided a figure of nine (9) for the sponsored in rural area.

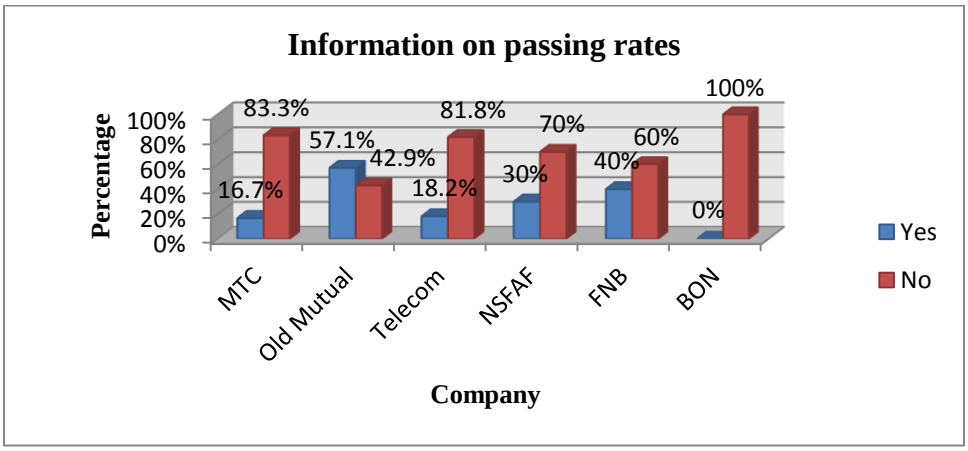

Figure 4.4: Sponsor respondents with information on passing rates

From the ten (10) questionnaires, only six (6) respondents answered this question at MTC, and of those six (6) only one (1) claimed to have access to information on student applicant passing rates. The result came out that eighty-three percent (83.3%) of individuals were without access to information on passing rates.

According to Figure 4.4, eighteen point two percent (18.2%) of respondents from Telecom had information on student passing rates. The rest of the respondents (81.8%) claimed not to have information on passing rates.

Figure 4.4 illustrates that zero percent (0%) of respondents from Bank of Namibia had information on student passing rates. Hundred percent (100%) claimed not to have information on passing rates.

In Figure 4.4 we deduced that fifty-seven point one percent (57.1%) of respondents from Old Mutual had information on student passing rates. The rest of the respondents (42.9%) claimed not to have information on passing rates. Fifty-seven point one percent (57.1%) respondents represented four (4) out of seven (7) participants.

According to Figure 4.4, forty percent (40%) of respondents from First National Bank had information on student passing rates. The rest of the respondents (60%) claimed not to have information on passing rates. Forty percent (40%) represented four (4) respondents out of ten (10).

Figure 4.4 depicted that thirty percent (30%) of Namibian Students Financial Assistance Fund respondents claimed to have access to information on student applicant passing rates. The chart showed seventy percent (70%) of individuals without access to information on passing rates.

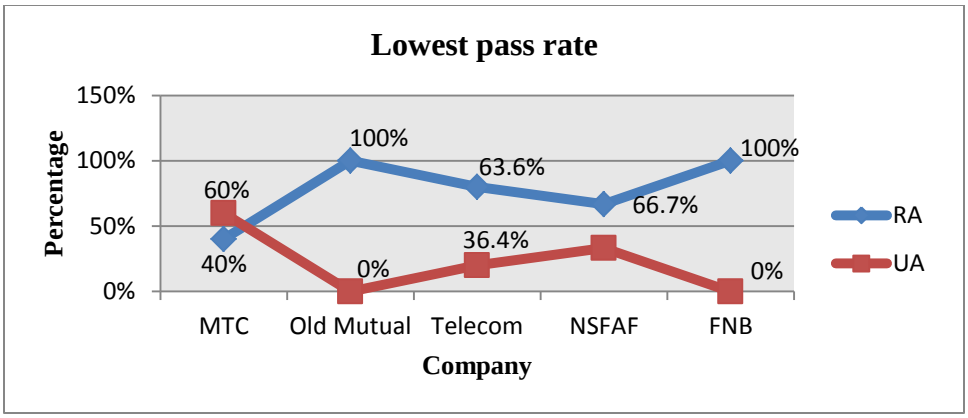

Figure 4.5: Low Passing Rates according to Sponsor respondents

According to MTC respondents, in urban, the lowest passing rate was sixty percent (60%). However, forty percent (40%) of respondents claimed that the group with the lowest pass rate was the rural area.

Figure 4.5 illustrated that the lowest pass rate according to Telecom was the rural area. Only thirty-six point four percent (36.4%) of the respondents claimed that the urban area had the lowest pass rate.

According to Old Mutual respondents, the group with a low pass rate was the rural area. About hundred percent (100%) of the respondents selected the rural area.

From figure 4.5 it was deduced that according to First National Bank respondents, the group with a low pass rate was from the rural area and hundred percent (100%) of them selected the same.

Figure 4.5 depicted that according to Namibian Students Financial Assistance Fund respondents, the remote area had the lowest pass rate at sixty-six point seven percent (66.7%) compared to thirty-three point three percent (33.3%) for the urban areas.

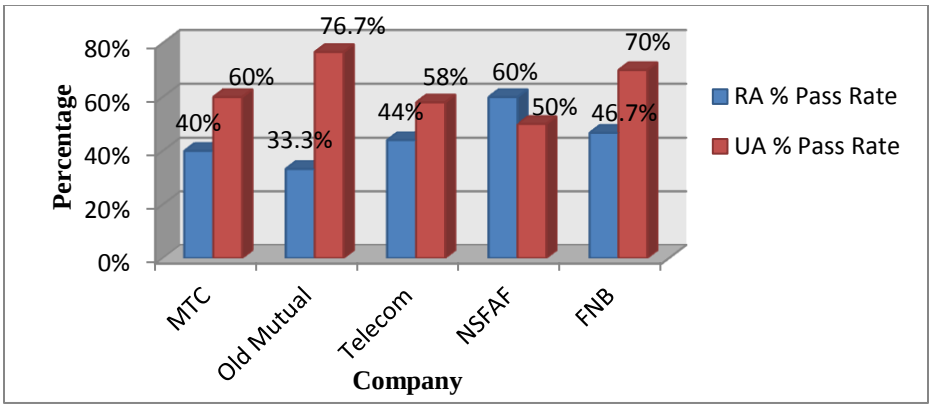

Figure 4.6: Rural and Urban passing rates according to sponsors

Figure 4.6 illustrated that the passing rates according to the MTC respondents were at sixty percent (60%) for urban areas, whereas forty percent (40%) were for rural. Sixty percent (60%) translated to three (3) respondents claiming the passing rates for the urban areas as opposed to two (2) participants.

According to the Telecom respondents, the pass rates from the rural areas were on average of forty-four percent (44%). Three (3) respondents put the passing rate for the remote area at forty percent (40%) whilst two (2) stated it at fifty percent (50%). According to the Telecom respondents, the pass rates from the urban areas were at fifty-eight percent (58%). One (1) of the respondents stated that the

passing rate for the urban area was at fifty percent (50%) whilst four (4) denoted it at sixty percent (60%).

From figure 4.6, Old Mutual respondents claimed that the pass rates from the rural areas were on average of thirty-three point three percent (33.3%). Two (2) respondents put the passing rate for the remote area at forty percent (40%) whilst one (1) placed it at twenty percent (20%). According to the Old Mutual respondents, the pass rates from the urban areas are at seventy-six point six seven percent (76.67%). One (1) of the respondents set the passing rate of the urban area at seventy percent (70%) whilst two (2) put it at eighty percent (80%).

In figure 4.6 it was deduced that the First National Bank respondents claimed that the pass rates from the rural areas were on average at forty-six point six seven percent (46.67%). Two (2) respondents at the bank stated that the pass rate for the remote area was at forty percent (40%) whilst one (1) placed it at sixty percent (60%). According to the First National Bank respondents, the pass rates from the urban areas were on average at seventy percent (70%). Three (3) respondents answered the question out of a total of ten (10). One (1) of the respondents stated that the pass rate for the urban area was at fifty percent (50%), whilst another denoted it at seventy percent (70%), and the last one indicated it at ninety percent (90%).

According to the Namibian Students Financial Assistance Fund respondents, the pass rates from the rural areas were at sixty percent (60%). One (1) of the respondents denoted the passing rate for the remote area at forty percent (40%) whilst two (2) stated it at seventy percent (70%). According to the Namibian Students Financial Assistance Fund respondents, the pass rates from the urban areas were at fifty percent (50%). One (1) respondent answered the question out of a total of ten (10).

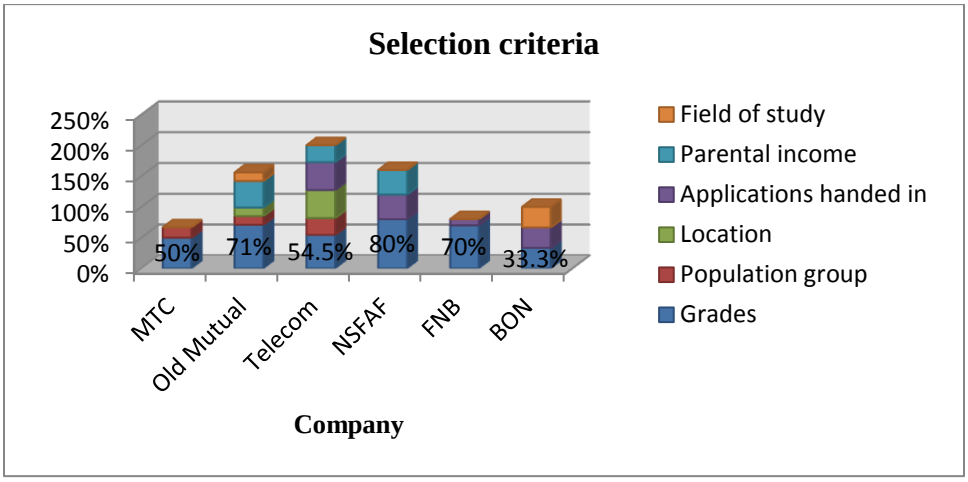

Figure 4.7: Selection criteria used according to sponsors

The selection criteria most used, according to Figure 4.7, was the grades. The grades were followed by 'Applications handed in' as well as 'Parental income' and 'Population group'. According to MTC respondents, the criteria used for selection at MTC were in two categories, namely: academic performance, which was the grades (50%) and population group (16.7%). One (1) respondents selected "Population group", whilst three (3) participants chose "Grades".

From figure 4.7 it was deduced that Telecom respondents stated the criterion used for selection at Telecom was mainly academic performance, which was the grades (54.5%). “Academic performance” measure was closely followed evenly by “Location” (45.5%) and “Applications handed in” (45.5%) as criteria for selection.

According to Bank of Namibia respondents, the criteria used for selection at BoN was academic performance, which was the grades, “Applications handed in” and “Field of study” at thirty-three point three percent (33.3%). According to Old Mutual respondents, the criteria used for selection at Old Mutual was mainly academic performance, which was the grades at seventy-one percent (71%). “Academic performance” measure was closely followed by “Parental income” at forty-three percent (43%). The bank used Location, Population group, and Field of study as selection criteria at fourteen percent (14%).

In figure 4.7, First National Bank respondents claim that the criteria used for selection at the bank was mainly academic performance, which was the grades at seventy percent (70%). “Academic performance” measure was followed by “Applications handed in” at ten percent (10%). According to Namibian Students Financial Assistance Fund respondents, the criteria used for selection was mainly academic performance, which was the grades at eighty percent (80%). “Academic performance” measure was followed by “Parental income” and “Applications handed in” at forty percent (40%) respectively.

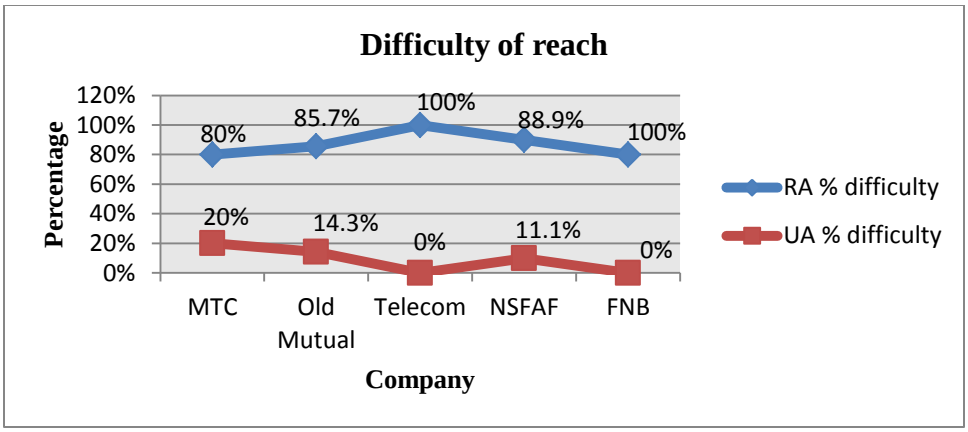

Figure 4.8: Difficulty of reach according to sponsors

According to the sponsors, as shown in Figure 4.8, the rural areas were the most difficult to reach compared to the urban areas. According to MTC, the group that had been most difficult to reach was the remote area. One (1) of the five (5) respondents to the question responded that the urban area was difficult to contact as opposed to the four (4) respondents who claimed that remote area was challenging to reach.

Figure 4.8 illustrated that to Telecom the group that had been most difficult to reach was the remote area. All the nine (9) respondents to the question responded that the remote area was challenging to reach. According to Old Mutual, the group that had been most difficult to reach was the remote area. Six (6) of the seven (7) respondents at Old Mutual claimed that the remote area was challenging to reach.

First National Bank, according to Figure 4.8, stated that the group that had been most difficult to reach was the remote area. Eight (8) respondents, hundred percent (100%), responded that the remote area was challenging to reach. According to the Namibian Students Financial Assistance Fund, the group that had been most difficult to reach was the remote area. Eight (8), which was eighty-eight point nine percent (88.9%), respondents responded that the remote area was challenging to reach compared to only one (1) proponent for urban area.

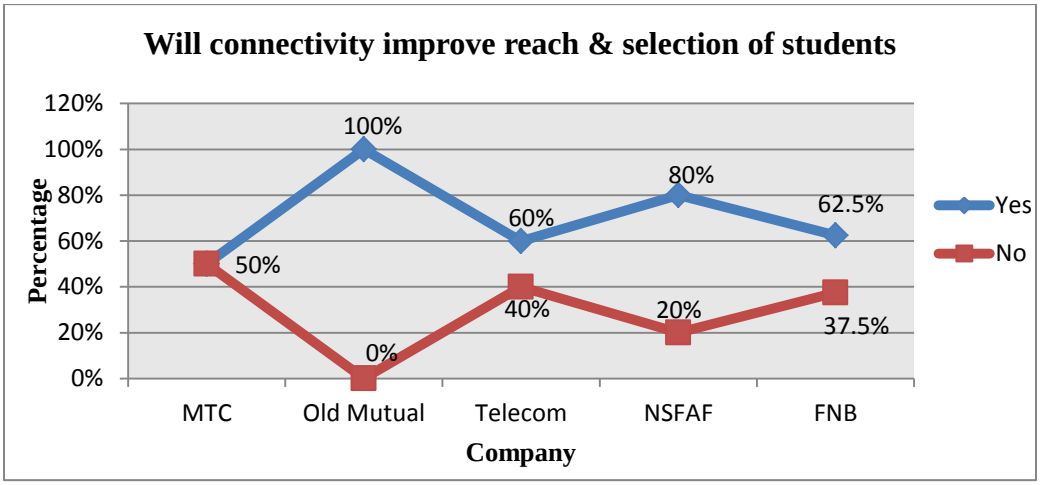

Figure 4.9: Connectivity improving student reach and selection according to sponsors

From Figure 4.9, according to questionnaire participants, it was deduced that connectivity would improve the reach of students from rural area as well as the selection process in tandem with equitable practices. According to MTC respondents, connectivity would more or less improve the situation for remote areas at fifty percent (50%) chance. The figure illustrated that most Telecom respondents, sixty percent (60%) agree that connectivity would improve the

student's situation in rural areas. About forty percent (40%) of the Telecom respondents disagreed.

Figure 4.9 illustrated that all Old Mutual respondents (100%), six (6) respondents, agreed that connectivity would improve the situation for students from rural area. The figure further illustrated that thirty percent (30%) of First National Bank respondents agreed that connectivity would improve the situation for students from rural area. Sixty-two point five percent (62.5%) of the FNB respondents agreed that connectivity would improve the situation between sponsors and students. Thirty-seven point five percent (37.5%), which was three (3) participants, disagreed that connectivity would improve the situation between sponsors and students.

In addition, Figure 4.9 demonstrated that eighty percent (80%) of the Namibian Students Financial Assistance Fund respondents agreed that connectivity would improve the situation for rural students. Eighty percent (80%) translated to four (4) participants, whilst ten percent (20%) translated to one (1) of the respondents to the question.

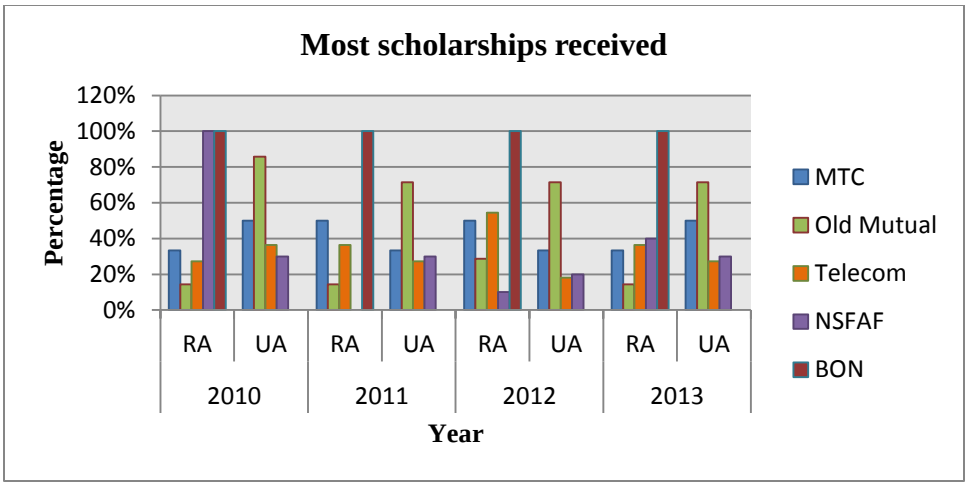

Figure 4.10: Most scholarships received according to sponsors

From the MTC and according to Figure 4.10 showed that in 2010 the urban area received more scholarships than the rural. In 2011 and 2012 the rural areas received more scholarships. However, in 2013, the urban areas again received the most grants from the Telecommunications provider.

From Telecom and according to Figure 4.10 illustrated that in 2010 the urban area received more scholarships than the rural. In 2011, 2012, and 2013 the rural areas received more scholarships from the connectivity service provider. Figure 4.10 showed that the Bank of Namibia had provided most scholarships to rural students in the years 2010 to 2013.

Most scholarships according to Old Mutual were given to urban students.

Figure 4.10 illustrated that the urban students received more scholarships than the rural from Old Mutual making it eighty-five point seven percent (85.7%) in 2010, and seventy-one point four (71.4%) in the consecutive years, 2011 to 2013.

The Namibian Students Financial Assistance Fund in Figure 4.10 depicted that the rural students received more scholarships than the urban in 2010. However, in the years 2011 and 2012 the urban area received more scholarships than rural. In 2013, the disbursement of awards went almost even at forty percent (40%) for rural to thirty percent (30%) for urban.

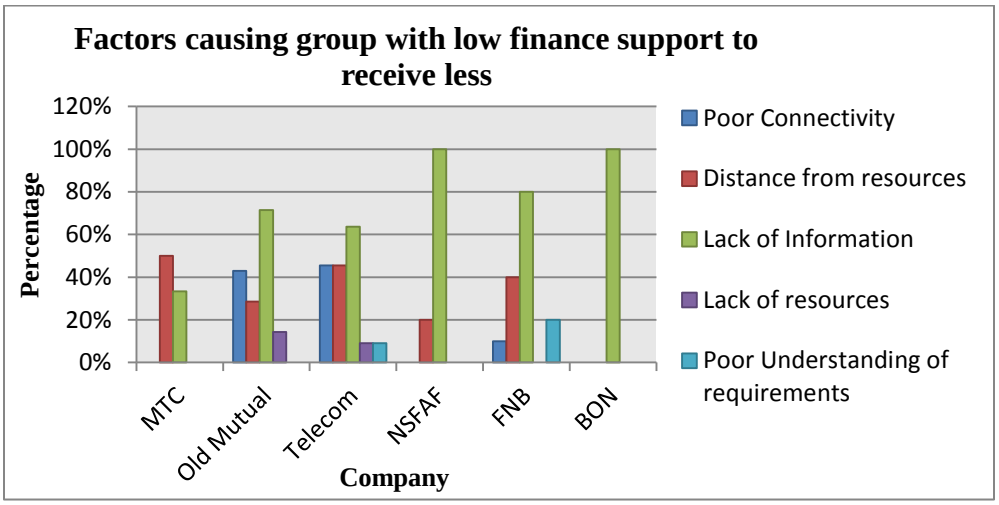

Figure 4.11: Factors causing low finance group to receive less according to sponsors

In Figure 4.11, it was deduced that the factors that caused the group with low financial assistance not to receive grants from MTC as “Distance from resources”

and “Lack of information”. Most respondents referred “Distance from resources” as the main factor.

Figure 4.11 showed that the main factor that caused the group with low financial assistance not to receive grants from Telecom was “Lack of information” (63.6%). “Poor Connectivity” and “Distance from resources” follow closely at forty-five point five percent (45.5%) respectively.

From Figure 4.11, it was observed that the main factor that caused the group with low financial assistance not to receive grants from Bank of Namibia was “Lack of information” (100%).

According to Figure 4.11, the main factor that caused the group with low financial assistance not to receive grants from Old Mutual was “Lack of information” (57.1%). “Poor Connectivity” and “Distance from resources” translated to twenty-eight point six percent (28.6%) respectively, with “Lack of resources” rounding up at fourteen point three percent (14.3%).

Figure 4.11 illustrated that the main factor that caused the group with low financial assistance not to receive grants from FNB was “Lack of information” (80%). “Distance from resources” was about forty percent (40%), and “Poor understanding of requirements” was at twenty percent (20%), with “Poor connectivity” rounding up to ten percent (10%).

In Figure 4.11, it was realised that the main factor that caused the group with low financial assistance not to receive grants from NSFAF was “Lack of information” (100%). “Distance from resources” was at twenty percent (20%).

4.1.1.2 Schools (students and teachers)

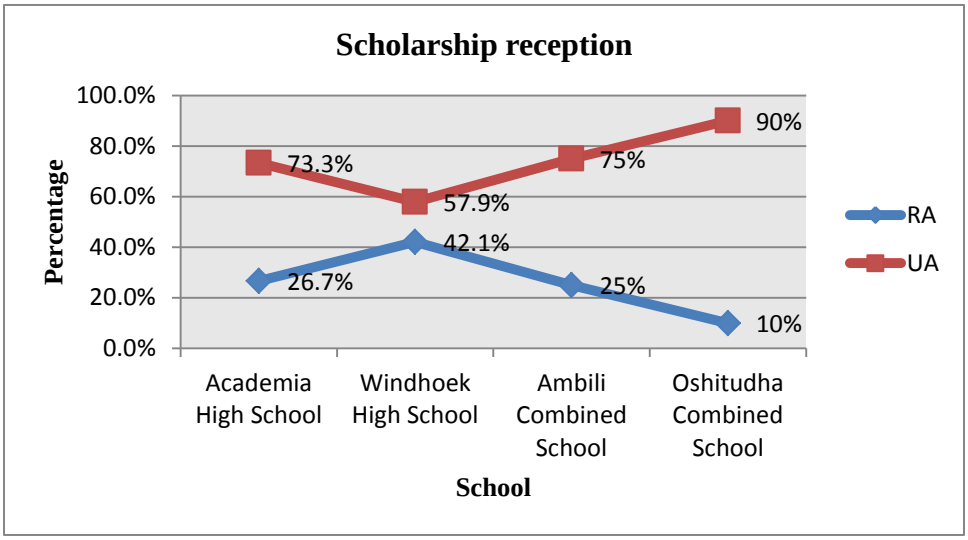

Figure 4.12: Group receiving most scholarships or grants according Schools

From Figure 4.12, it was observed that the urban area had been receiving the most grants at seventy-three point three percent (73.3%). Eleven (11) of the fifteen (15) respondents to the question from Academia High School selected the urban areas, while four (4) chose the rural areas.

In Figure 4.12, it was deduced that the urban area had been receiving the most grants at fifty-seven point nine percent (57.9%). Eleven (11) of the nineteen (19)

respondents to the question from Windhoek High School selected the urban areas, while eight (8), forty-two point one percent (42.1%), chose the rural areas.

According to Figure 4.12, the urban area had been receiving the most grants at seventy-five percent (75%). Fifteen (15) of the twenty (20) respondents to the question from Ambili Combined School selected the urban areas, while five (5), forty-percent (25%), chose the rural areas.

Figure 4.12 illustrated that the urban areas had been receiving the most grants at ninety percent (90%). Nine (9) of the ten (10) respondents to the question from Oshitudha Combined School selected the urban areas, while one (1), which was ten percent (10%), chose the rural areas.

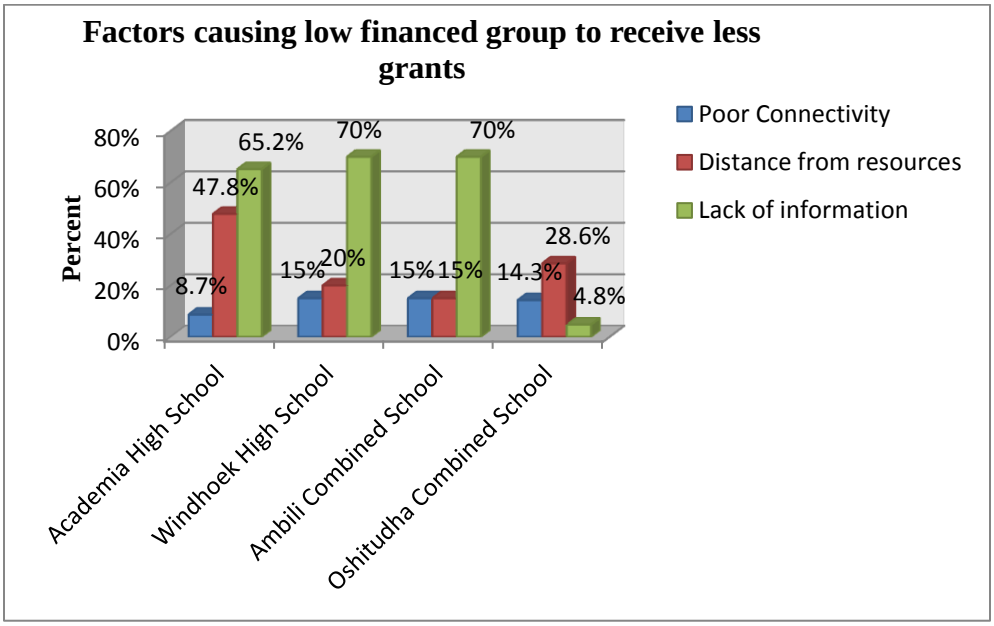

Figure 4.13: Factors causing low financing according to Schools

According to Academia High School the main factor that caused the group with low financial assistance not to receive grants was “Lack of information” (65.2%). “Distance from resources” followed with forty-seven percent (47.8%), followed by “Poor connectivity” at eight point seven percent (8.7%).

Sixty-five point two percent (65.2%) translated to fifteen (15) respondents selecting “Lack of information” out of twenty-three (23). Forty-seven percent (47.8%) translated to eleven (11) respondents selecting “Distance from resources”. Eight point seven percent (8.7%) translated to two (2) respondents selecting “Poor connectivity”.

In Figure 4.13, it was deduced that the main factor according to Windhoek High School that caused the group with low financial assistance not to receive grants was “Lack of information” (70%). “Distance from resources” followed at twenty percent (20%). The “Poor connectivity” was at fifteen percent (15%). Seventy percent (70%) translated to fourteen (14) respondents selecting “Lack of information” out of the twenty (20). Four (4) respondents selected “Distance from resources”. Three (3) respondents selected “Poor connectivity”.

Figure 4.13 illustrated that the main factor according to Ambili Combined School that caused the group with low financial assistance not to receive grants was “Lack of information” (70%). “Distance from resources” and “Poor connectivity” was at fifteen percent (15%) respectively. Seventy percent (70%) translated to

fourteen (14) respondents selecting “Lack of information” out of the total of twenty (20). Three (3) respondents selected “Distance from resources” and “Poor connectivity” respectively.

From Figure 4.13, Oshitudha Combined School declared that the main factor that caused the group with low financial assistance not to receive grants was “Distance from resources” (28.6%). “Poor connectivity” was at fourteen point three percent (14.3%). Twenty-eight point six percent (28.6%) translated to six (6) respondents selecting “Distance from resources” out of the twenty one (21). Four point eight percent (4.8%) selected “Lack of information”. Three (3) respondents selected “Poor connectivity”. One (1) respondent chose “Lack of information”.

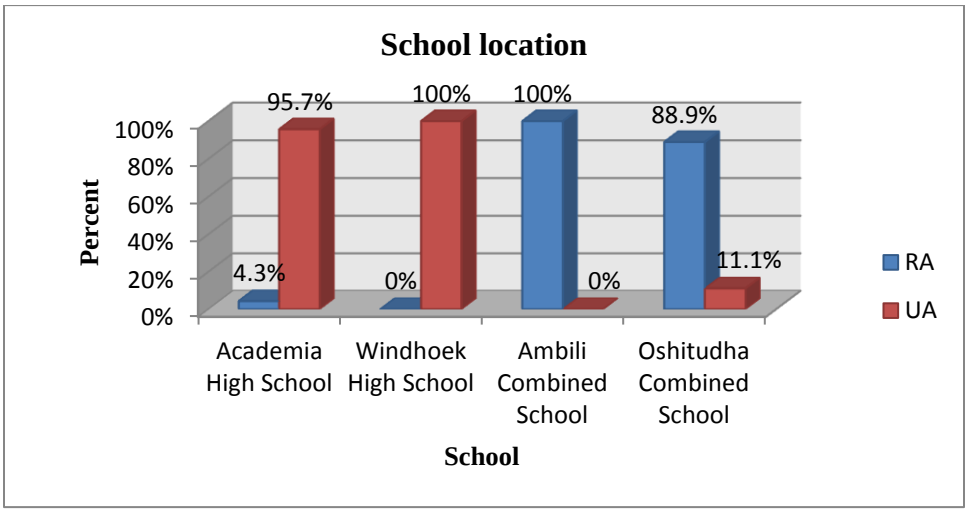

Figure 4.14: Location of Schools according to respondents

According to Figure 4.14, ninety-five point seven percent (95.7%) of the respondents claimed that Academia High School was in the urban area, while four

point three percent (4.3%) claimed the school was in a rural area. Twenty-two (22) respondents, which translated to ninety-five point seven percent (95.7%), placed the school in the urban area, as opposed to one (1) participant.

In Figure 4.14, a hundred percent (100%) of the respondents, which represented nineteen (19) participants, claimed that Windhoek High School was in the urban area. The rural area was not selected.

From Figure 4.14, a hundred percent (100%) of the respondents, which represented twenty (20) participants, claimed that Ambili Combined School was in the rural area.

Figure 4.14 illustrated that Oshitudha Combined School was in the rural area as denoted by thirty-eight point one percent (38.1%) of the respondents, while four point eight percent (4.8%) claimed the school was in urban area. Eight (8) respondents placed the school in the rural area, as opposed to one (1) participant.

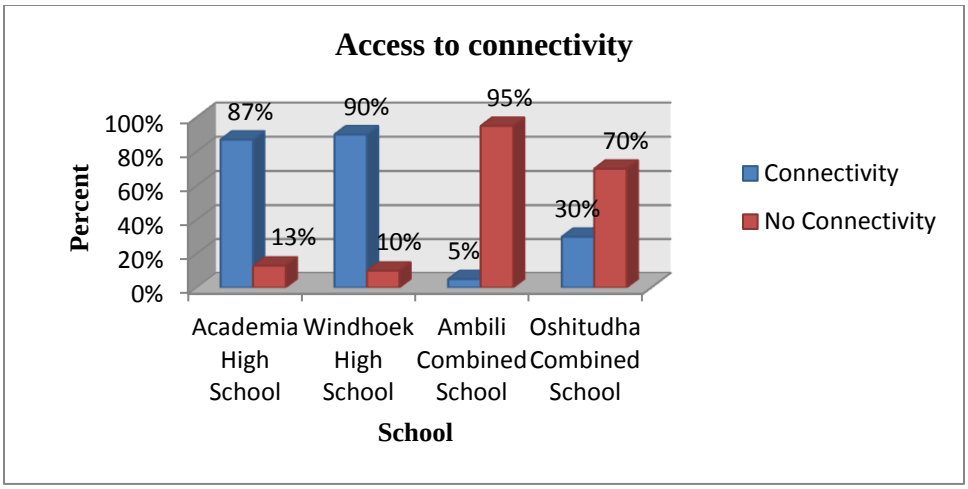

Figure 4.15: Connectivity at Schools according to respondents

It was observed from Figure 4.15, that eighty-seven percent (87%) of respondents agreed that Academia High School was a school with connectivity services available. Thirteen percent (13%) of respondents declined that connectivity services existed at the school. Twenty (20) of the respondents agreed that the school had connectivity services, whilst only three (3) claimed that connectivity did not exist at the school.

From Figure 4.15, it was deduced that ninety percent (90%) of respondents agreed that Windhoek High School was a school with connectivity services available. Ten percent (10%) of respondents declined that connectivity services existed at the school. Eighteen (18) of the respondents agreed that the school had connectivity services, whilst only two (2) claimed that connectivity did not exist at the institution.

Figure 4.15 showed that ninety-five percent (95%) of respondents agreed that Ambili Combined School was a school without connectivity. Five percent (5%) of respondents claimed that connectivity services existed at the school. Nineteen (19) of the respondents disagreed that the school had connectivity, whilst only one (1) claimed that connectivity existed at the school.

According to Figure 4.15, indicated that seventy percent (70%) of respondents agreed that Oshitudha Combined School was a school without connectivity. Thirty percent (30%) of respondents claimed that connectivity services existed at the school. Seven (7) of the respondents disagreed that the school had connectivity, whilst only three (3) claimed that connectivity existed at the school.

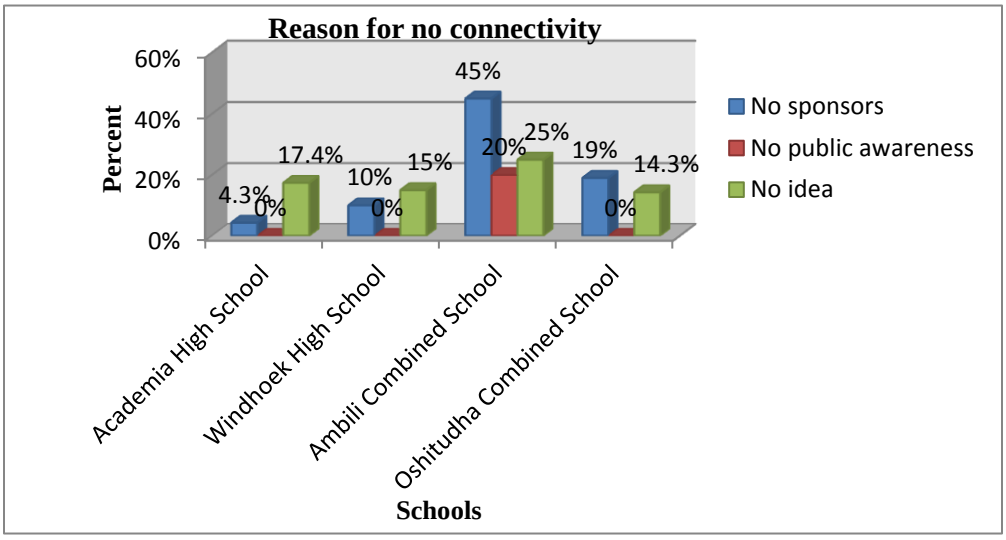

Figure 4.16: Reasons for no connectivity at Schools according to respondents

From Figure 4.16, it was deduced that the reasons for no connectivity were lack of sponsors represented by four point three percent (4.3%) and "No idea" at seventeen point four percent (17.4%). One (1) respondent chose "No sponsors"

and four (4) respondents had “No idea” for a reason that connectivity was not available at schools according to Academia High School.

According to Figure 4.16, it was deduced that the reasons for no connectivity were the lack of sponsors at ten percent (10%) and “No idea” at fifteen percent (15%). Two (2) respondents chose “No sponsors” and three (3) respondents had “No idea” for a reason that connectivity was not available according to Windhoek High School.

Ambili Combined School declared that the reasons for no connectivity were the lack of sponsors at forty-five percent (45%) and “No public awareness” at twenty percent (20%). Twenty-five percent (25%) of respondents had “No idea”. Nine (9) respondents chose “No sponsors” and four (4) respondents had “No public awareness”.

In Figure 4.16, it was determined that the reasons for no connectivity were the lack of sponsors at nineteen percent (19%) and “No idea” at fourteen point three percent (14.3%).

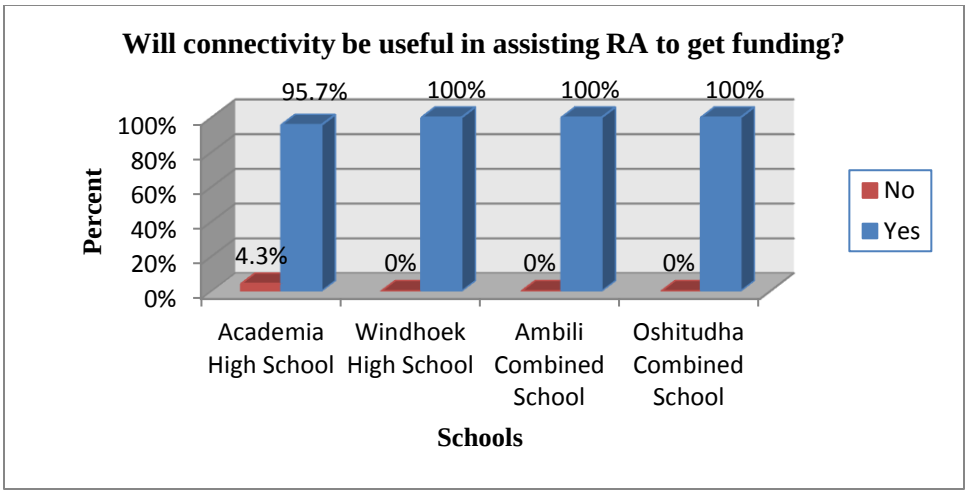

Figure 4.17: School response on connectivity assisting RA students in getting funding

Figure 4.17 indicated that ninety-five point seven percent (95.7%) of the Academia High School respondents claimed that connectivity would be useful in assisting students from rural areas. Four point three percent (4.3%) of the respondents claimed that connectivity would not assist students from rural areas. Twenty-two (22) respondents claimed that connectivity would assist the students from rural areas getting funding. One (1) respondent claimed that connectivity would not assist the students from rural areas getting funding.

From Figure 4.17 indicated that hundred percent (100%) of the Windhoek High School respondents claimed that connectivity would be useful in assisting students from rural areas receiving funding. All twenty (20) respondents claimed that connectivity would assist students from the rural areas getting funding.

According to Figure 4.17, hundred percent (100%) of the Ambili Combined School respondents claimed that connectivity would be useful in assisting students from rural areas receiving funding. All twenty (20) respondents claimed that connectivity would assist the students from rural areas getting funding.

Figure 4.17 illustrated that hundred percent (100%) of the Oshitudha Combined School respondents claimed that connectivity would be useful in assisting students from rural areas receiving funding. All twenty-one (21) respondents claimed that connectivity would assist the students from rural areas getting funding.

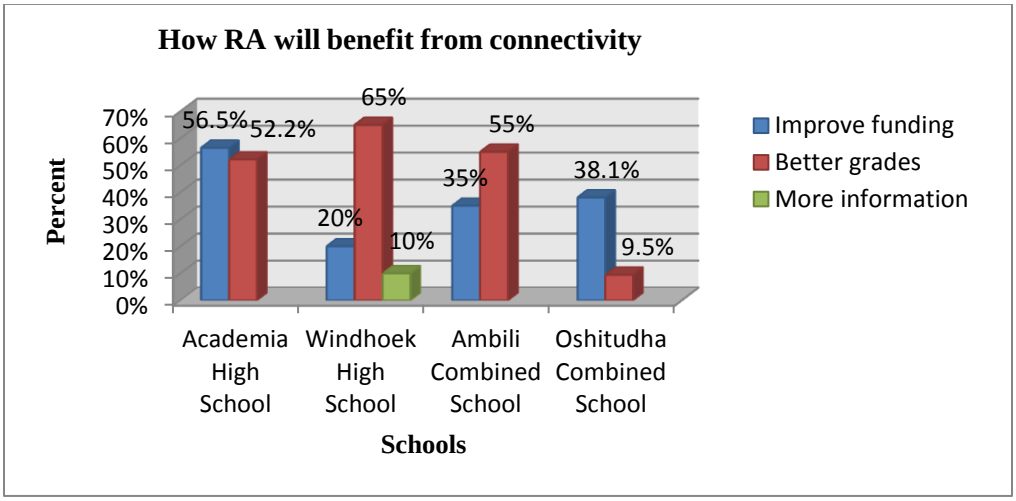

Figure 4.18: How RA students will benefit from connectivity

From Figure 4.18, it was deduced that fifty-six point five percent (56.5%) of the Academia High School respondents claimed that connectivity would assist students from rural areas with “Improved funding”. Fifty-two point two percent

(52.2%) of them achieve “Better grades”. Thirteen (13) respondents selected “Improved funding”, whilst twelve (12) respondents chose “Better grades”.

According to Figure 4.18, it was observed that six-five percent (65%) of the Windhoek High School respondents claimed that connectivity would assist rural students with “Better grades”. Twenty percent (20%) of the respondents claimed that connectivity would assist rural students achieve “Improved funding”. Ten (10%) declared that connectivity would assist students achieve “More information”. Thirteen (13) respondents selected “Better grades”, whilst four (4) chose “Improved funding”. Two (2) respondents nominated “More information”.

Figure 4.18 illustrated that fifty-five percent (55%) of the Ambili Combined School respondents claimed that connectivity would assist students from rural get “Better grades”. Thirty-five percent (35%) of the respondents claimed that connectivity would assist rural students achieve “Improved funding”. Seven (7) respondents selected “Improved funding”, whilst eleven (11) respondents chose “Better grades”.

In Figure 4.18, it was realised that thirty-eight point one percent (38.1%) of the Oshitudha Combined School respondents claimed that connectivity would assist rural students with “Improved funding”. Nine percent (9.5%) of the respondents claimed that connectivity would assist rural students to achieve “Better grades”.

Eight (8) respondents selected “Improved funding”, whilst two (2) respondents chose “Better grades”.

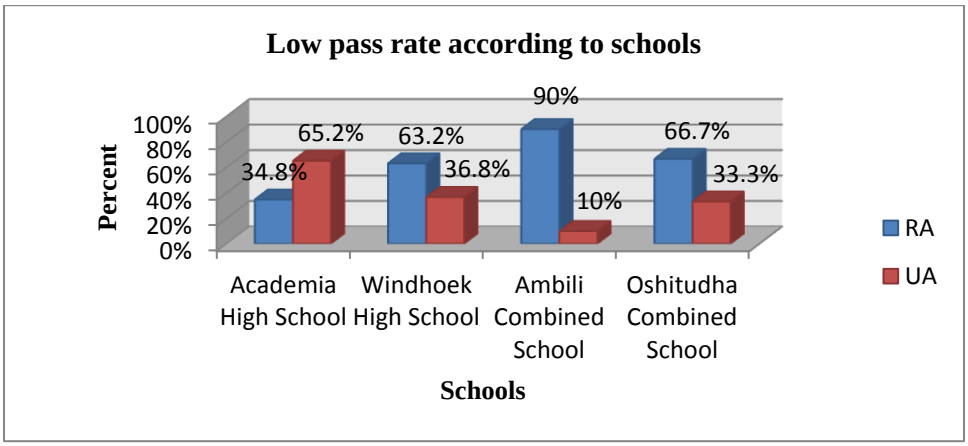

Figure 4.19: Lowest pass rates according to the schools

Figure 4.19 showed that sixty-five point two percent (65.2%) of Academia High School respondents claimed that the urban area had a low pass rate that the rural area. Thirty-four point eight percent (34.8%) declared that the rural area had a low pass rate than the urban area. Fifteen (15) respondents asserted that the urban area had a low pass rate as opposed to eight (8).

According to Figure 4.19, sixty-three point two percent (63.2%) of Windhoek High School respondents claimed that the rural had a low pass rate than the urban ones. Thirty-six point eight percent (36.8%) declared that the urban area had a low pass rate. Twelve (12) respondents asserted that the rural had a low pass rate as opposed to seven (7).

Figure 4.19 illustrated that ninety percent (90%) of Ambili Combined School respondents claimed that the students from rural had a low pass rate than the urban ones. Ten percent (10%) declared that the urban area had a low pass rate than the rural area. Eighteen (18) respondents asserted that the students from rural areas had a low pass rate as opposed to two (2).

From Figure 4.19, it was deduced that sixty-six point seven percent (66.7%) of Oshitudha Combined School respondents claimed that the students from rural area had a low pass rate than the urban ones. Thirty-three point three percent (33.3%) declared that the urban area had a low pass rate than the rural area. Six (6) respondents asserted that the rural area had a low pass rate as opposed to three (3).

4.1.2 Interview Feedback Analysis

4.1.2.1 General grant students

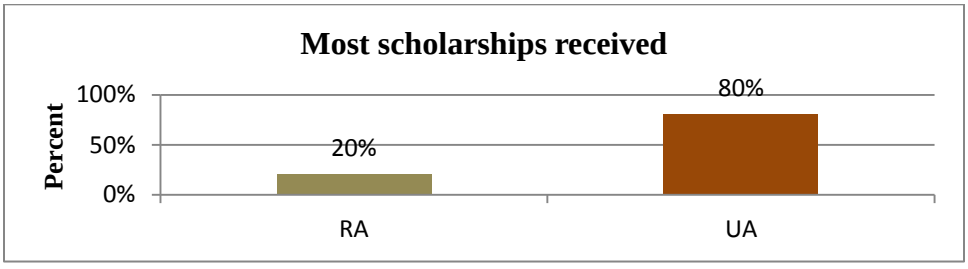

Figure 4.20: Group that had received most scholarships according to respondents

Figure 4.20 illustrated that the students from the urban area received more scholarships than the rural according to the respondents (80%). Eight (8)

respondents claimed that the urban area had received the most scholarships, whilst two (2) declared the opposite.

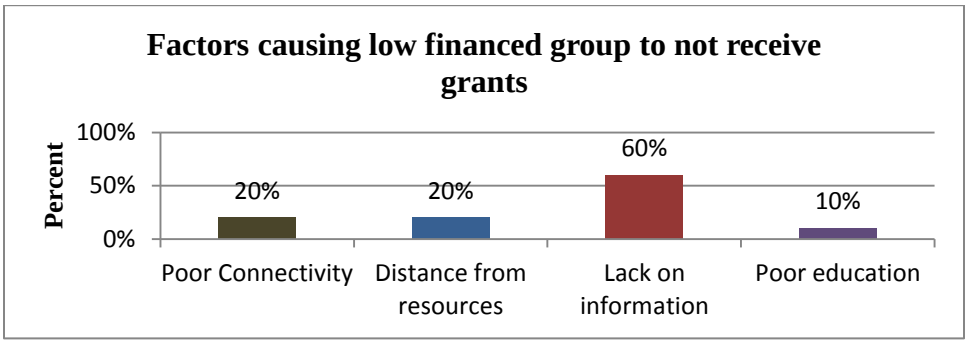

Figure 4.21: Factors causing low financing according to respondents

In Figure 4.21, it was deduced that the main factor that caused the group with low financial assistance not to receive grants was "Lack of information" (60%). "Poor connectivity" and "Distance from resources" indicated twenty percent (20%). Ten percent (10%) of the respondents selected "Poor education". Sixty percent (60%) translated to six (6) respondents selecting "Lack of information" out of the total ten (10). Twenty percent (20%) translated to two (2) respondents selecting "Poor connectivity" and "Distance from resources". One (1) respondent chose "Poor education".

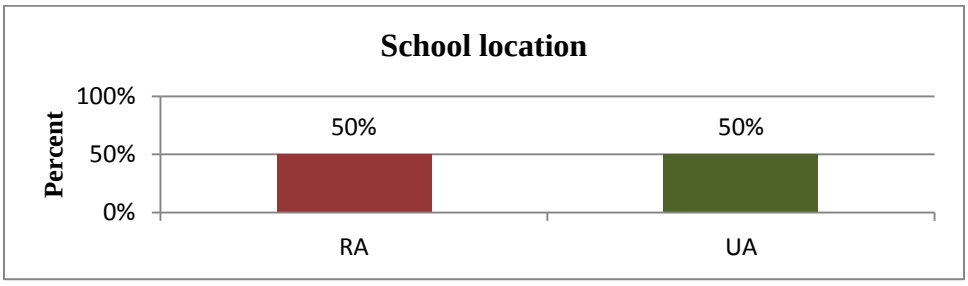

Figure 4.22: Location of school studied at by respondents

According to Figure 4.22, fifty percent (50%) of the grant students were from the urban area whilst the other was from the rural areas. Five (5) respondents indicated the schools from the urban received the grant.

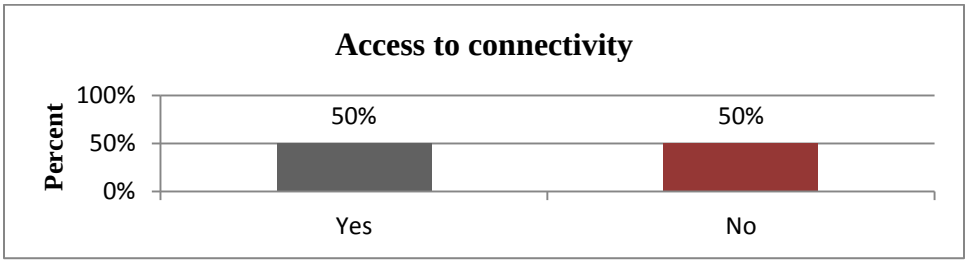

Figure 4.23: Access to connectivity at respective schools studied at by respondents

It was observed from Figure 4.23, that fifty percent (50%) of respondents agreed that their school had connectivity. The rest of respondents declined that connectivity services did not exist at their schools.

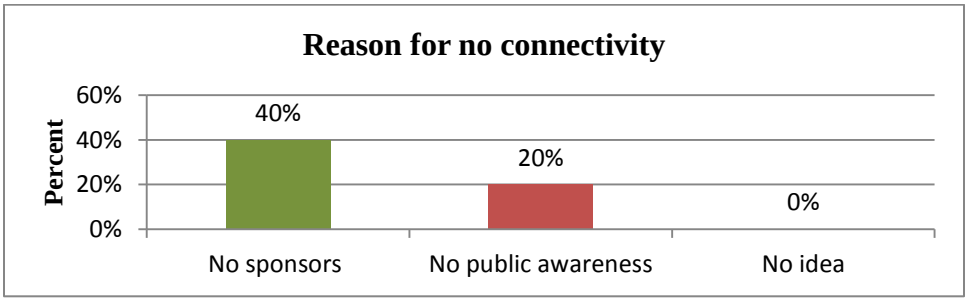

Figure 4.24: Reasons for no connectivity at respective schools according to respondents

From Figure 4.24, it was deduced that the reasons for no connectivity (forty percent (40%)) was lack of sponsors and "No public awareness" was indicated by twenty percent (20%).

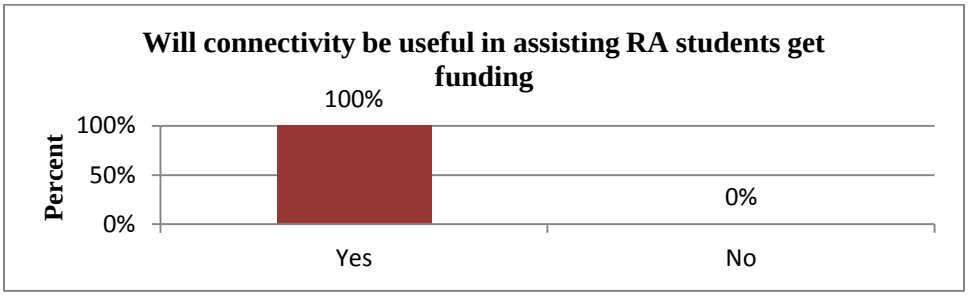

Figure 4.25: Connectivity usefulness according to respondents

Figure 4.25 indicated that hundred percent (100%) of the respondents claimed that connectivity would be useful in assisting students from rural areas to receive funding.

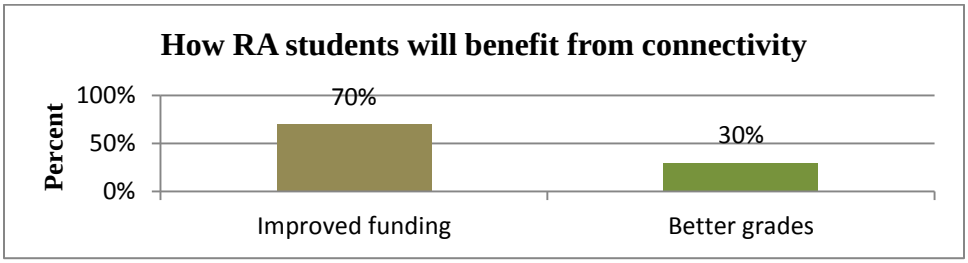

Figure 4.26: How rural area students will benefit from connectivity according to respondents

From Figure 4.26, it was observed that seventy percent (70%) of the respondents claimed that connectivity would assist students from the rural areas have "Improved funding". Thirty percent (30%) of the respondents claimed that

connectivity would assist rural students achieve “Better grades”. Seven (7) respondents selected “Improved funding”, whilst three (3) chose “Better grades”.

4.1.2.2 Sponsors (Human Resource and Engineer responses):

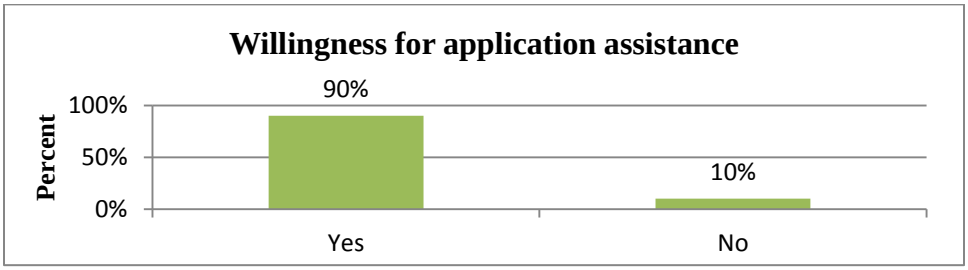

Figure 4.27: Sponsors willingness to have support from ACRCF technology

According to Figure 4.27, all the sponsors (90%) that responded to the question were willing to have technological assistance in the student selection process. The BoN respondent was however critical of technological assistance.

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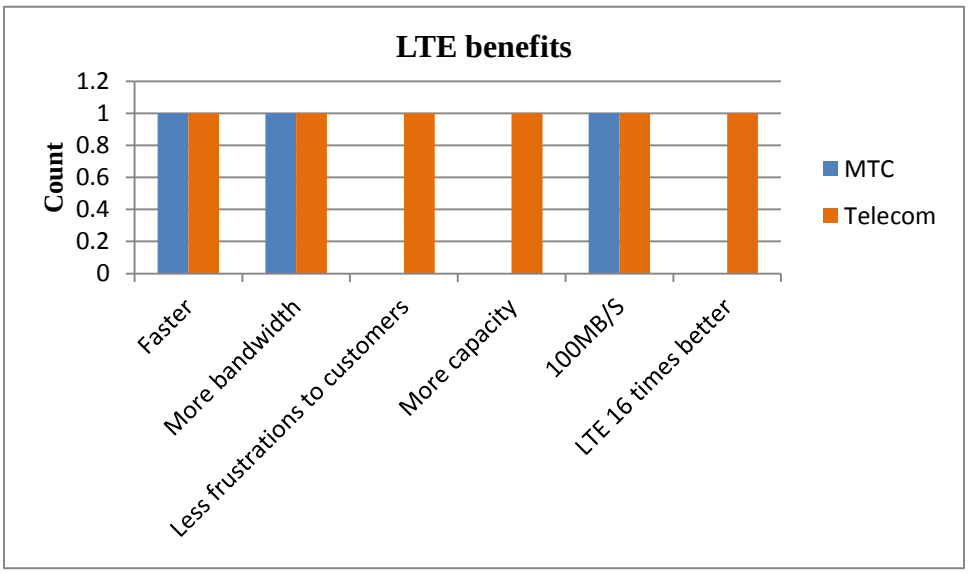

Figure 4.28: Benefits of LTE per connectivity service provider

Figure 4.28 demonstrated the LTE benefits on connectivity. MTC observed that LTE was faster at hundred Megabytes per second (100 MB/S) and also provided a higher bandwidth. Also Telecom noted that LTE provided faster speed, and more bandwidth.

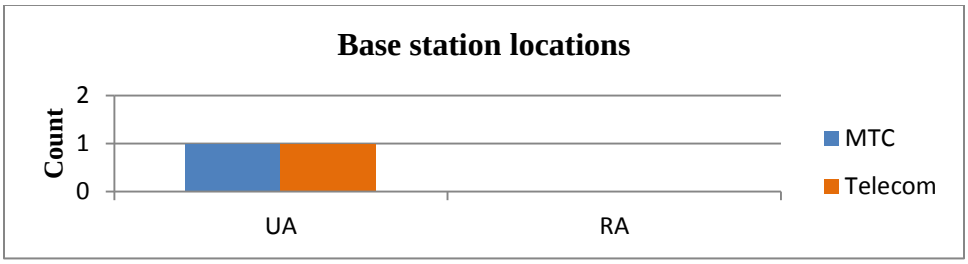

Figure 4.29: Location of most base stations according connectivity service provider

According to Figure 4.29, the locations of most base stations are in the urban areas. Both MTC and Telecom claimed that most of their base stations were in the towns or cities.

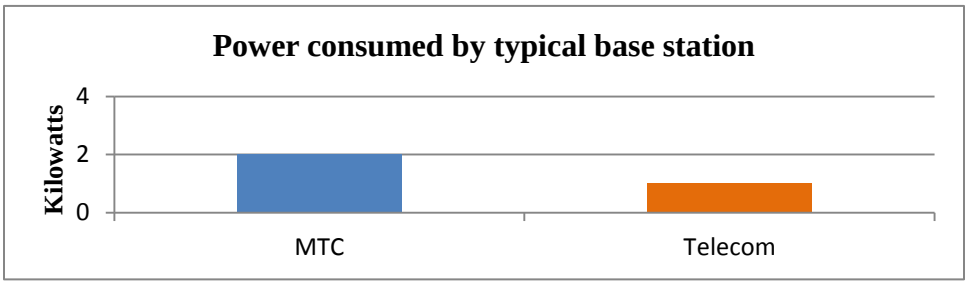

Figure 4.30: Power consumed by typical base station according connectivity service provider

Figure 4.30 illustrated the power consumption by a typical base station. MTC claimed that their base stations consumed about two (2) Kilowatts of electricity. Telecom declared that their base stations consumed less than two (2) kilowatts of electricity.

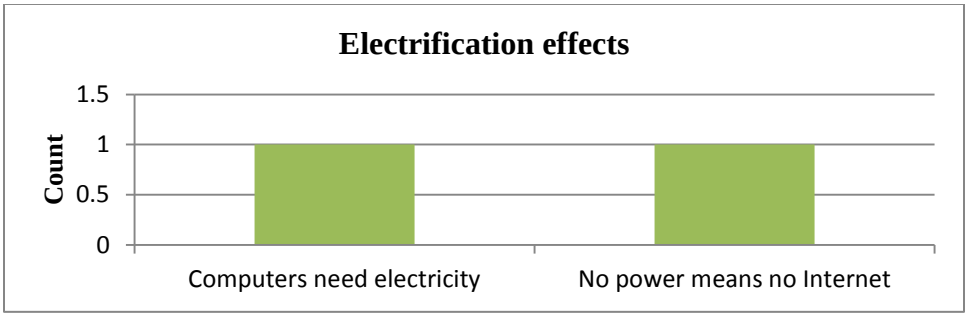

Figure 4.31: Effects of electrification on connectivity according to Nampower

Figure 4.31 deduced the effects of electrification. Nampower claimed that electrification was important for computers to function. The state facility also claimed that without power the Internet would not function in locations without power supply.

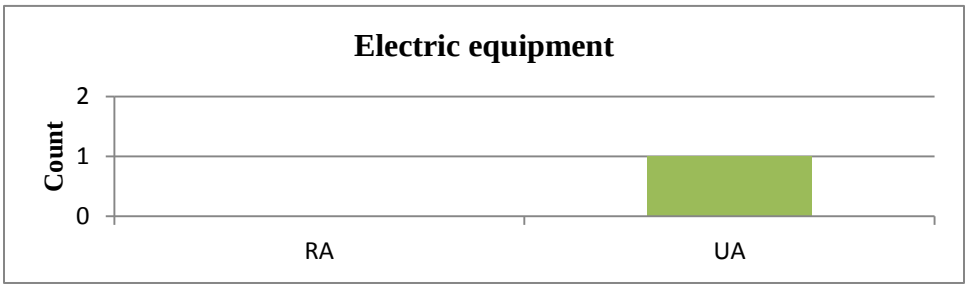

Figure 4.32: Location of most electrification equipment according to Nampower

In Figure 4.32, it was observed that the location of most Nampower electrical equipment was in the urban areas. The rural areas had nothing or less power infrastructure than the urban.

4.2 Discussion

The digital divide between the urban and rural areas in terms of connectivity between had been an overlooked area. The researcher was prompted to envisage the ACRCF for the underlined problem (see chapter 1). Below, the discussion was divided into statistical, questionnaire and interview implications. The questionnaire data discussion was divided further into subsections: Sponsors and Students, Human Resource and Engineer inferences from the data presented in the previous chapter.

4.2.1 Statistical Definitions

According to Swift and Piff (2010) the measure that was most widely used to gauge the strength of the relationship between the standard deviation of x and the standard deviation of y was the sample correlation, which was usually represented by the symbol r. In agreement with the authors, this section would look further into the findings to analyse correlations in order to discover the nature of data relationships from the data presented. In addition, simple random sampling measures would be used to derive estimations about the populations in the study.

The formula for correlation was represented as follows:

r = cov (x, y) / (SxSy)

whereby,

r = sample correlation coefficient

cov (x, y) = covariance between x and y

SxSy = Product of the standard deviations of x and y.

Correlation measures:

r = 1, is a perfect relationship

r = 0, means no relationship

r = -1, is a negative relationship

4.2.2 Questionnaire Data Discussion

4.2.2.1 Sponsors

The discussion focussed on measures in promoting fairness in scholarship awarding. The variables that the sponsors would consider to affect the selection of students for scholarships were of most importance in consideration of equitability.

In reference to Table 4.3 (see APPENDIX D), the relationship between lowest pass rate and difficulty of reach was discussed as follows: The data showed that the remote area had the lowest pass rate according to sponsors (see Figure 4.5). The remote area was found to be the most difficult to reach or connect according to the sponsors (see Figure 4.8). The implications of the remote area having a low pass rate does not seem to affect the difficulty of reach however as the correlation

between the two was relatively low at r = 0.349. The relationship between the x and y variables was quite insignificant as it was between 0.5 and 0, which was weak because it was close to zero (0). The sponsors agreed that the passing of students was not related to the difficulty in reaching those students for scholarships. The students could be in the far remote regions, passing well or not, yet the reaching of those students by the sponsors, whether with ease or difficulty was not attached to their grades.

The association between lowest pass rate and criteria of selection was discussed as follows (see Table 4.4, APPENDIX D): The criterion of selection was to consider the results (see Figure 4.7). The implications of the remote area having a low pass rate does not seem to affect the criteria of selection according to grades however as the correlation between the two was relatively low at r =0.107. The relationship between the x and y variables was quite insignificant as it was much closer to zero (0) between lowest rate pass and grades. The low pass rate and the location did however seem to have a strong relationship. The correlation between the variables x and y for low pass rate and location was at r = 0.643. The relationship was significant because the correlation coefficient r = 0.643 was close to one (1), which implied a perfect or strong relationship, than it was to zero (0).

The relationship between the low pass rate and the population group was even stronger. The correlation between the variables x and y for the low pass rate and

population group was r = 0.748. Hence, it was an even stronger relationship as r =0.748 was closer to one (1). Low pass rate and applications handed in had a weak relationship. The correlation between the variables of the two selections was r = 0.311. The relationship between the lowest pass rate and parental income was the closest compared to the rest of the relationships highlighted. The correlation between the x and y variables of the two selections was at r = 0.905. The value of that relationship was close because it was much closer to one (1), which was perfect. From the data presented, we can infer that the low pass rates in remote areas were a result of the school children coming from poor backgrounds (low parental incomes). According to the Namibia Statistics Agency (NSA), poverty was highest in the Kavango and Caprivi regions. The report further said that sixty-eight percent (68%) of Khoisan main language speakers were poor. Correspondingly, since the lowest pass rates were closely related to population group, there had been a need for the ACRCF sponsors to consider selection according population group regions. The consideration of regions would help with improving choices by keeping the poorest and richest areas in view.

According to Table 4.5 (see APPENDIX D), the relationship between connectivity and factors causing low finance to RA was discussed as follows: Majority (80%) of the sponsors propose that connectivity would improve the reach out of students from remote areas as well as the selection process with respects to equitable practices (see Figure 4.9). According to Figure 4.11, one was able to deduce that “lack of information” was the main factor chosen by sponsors

as the leading cause of poor finance to those that receive less support. The “Lack of information” was followed by “Distance from resources”, which was in turn trailed by “Poor Connectivity”. The correlation between “Lack of information” and “Poor Connectivity” was moderately positive at r = 0.6249. The plausibility of the two variables affecting each other was obvious in the remote areas. The sponsors would not be able to provide information, for instance on scholarships, to students at non-connected remote schools. The “Distance from resources” also had a moderately positive correlation with “Lack of information” at r =0.6637. The further away sponsors were from the students, the less information reached the students.

When connectivity improvement was correlated with “Lack of resources” there was a weak positive relationship at r = 0.2887. The result showed that connectivity improvement was not related to “Lack of resources”. In reality, connectivity enhances the availability of resources for the students. There was a much weaker correlation between connectivity improvement and “Poor understanding of requirements” at r = 0.1768. Students could still misunderstand scholarship requirements and information even if connectivity services were available at the schools.

4.2.2.2 Students

The discussion will focus on access to connectivity in remote schools for improved scholarship distribution. Inferences from the variables that the students

considered to affect connectivity and its relationship to equitable scholarship awarding processing were discussed.

Relative to Table 4.6 (see APPENDIX D), the relationship between scholarship reception, school location and access to connectivity was discussed as follows:

The correlation between scholarship reception and school location with respects to the remote areas was r = -0.3809. There was technically a negative relationship between the variables, scholarship reception and school location, in terms of the remote areas. The relationship was weak, but a school that was in a remote area away from scholarship information would not have students that were aware of the latest grants available from the sponsors as a result. More scholarship information would be useless if it was not available to the remote areas.

In terms of the urban areas, the correlation between scholarship reception and school location was r = 0.3377. There was a technically positive correlation found between the variables, scholarship reception and school location in terms of the urban areas. The relationship between the variables, scholarship reception and school location, was weak. However a school in the urban area was more likely to benefit from the readily available scholarship information.

The correlation between scholarship reception and “No connectivity” was r = -0.2163. Although a weak relationship, it was a technically negative correlation between the variables. The two variables acted reciprocally, which meant that the

more scholarship reception increases for the remote areas, the less "No connectivity" values increased. In contrast, the correlation between scholarship reception and "Connectivity" was at r = 0.3141. Although a weak relationship, it was a technically positive correlation between the variables. Hence, the scholarship reception in the urban areas increased with connectivity.

In reference to Table 4.7 (see APPENDIX D), the relationship between connectivity usefulness and how RA will benefit from connectivity was discussed as follows: All the respondents to the questionnaires, except for one, agreed that connectivity would be useful in assisting with funding. In terms of how connectivity would benefit the students, the relationship between connectivity usefulness and improved funding was at r = 0.3807. Although it was weak, there was a technically positive correlation between the variables, "connectivity usefulness" and "improved funding". Similarly, the relationship between connectivity usefulness and better grades was even higher at r = 0.9648. There was a strong positive correlation between the variables, "connectivity usefulness" and "better grades".

Connectivity can help students to get study information at their fingertips. The connectivity factor can hence assist students with getting better grades, which in turn would attract higher funding from sponsors. The relationship between "connectivity usefulness" and "more information" was technically positive in correlation, even though the relationship between the variables was weak at r =

0.3857. The result infers that the more connectivity, the more information for the students.

4.2.3 Interview Data Discussion

In view of Table 4.8 (see APPENDIX D), the relationship between applications received and selection students was discussed as follows: Only thirty-three percent (33.3%) of sponsors could provide information on the number of applications they had received. The ACRCF would assist the sponsors to have information about applicants and to help with improved decision making. The correlation between applications received and selected students for Telecom was r = - 0.3337. Although technically a weak correlation, there was a negative relationship between the variables, applications received and selected students. Hence, the effect of the number of applications handed in to Telecom plays a little role in how many students are selected for scholarships. The correlation for Old Mutual was undefined. It suffices to say that from the data given, that Old Mutual keeps to a levelled number of students, which was ten (10), irrespective of the volume of applications received.

In reference to Table 4.9 (see APPENDIX D), the relationship between number of base stations and infrastructure costs was discussed as follows: The correlation between the number of base stations and the infrastructure costs was technically negative at r = -1. The relationship was weak because there was only data from

the two main telecommunications companies in Namibia, MTC and Telecom Namibia, to provide a significant value. The equation of regression was:

$y = -2000 + 270000x$ for the amount of variables given on base stations to infrastructure costs. From the data, one can tell that the more infrastructure, the less the cost to obtain it. Hence, if there was a consortium of ACRCF companies that pull resources together to obtain infrastructure, it would be cheaper for the entities involved instead of individual purchasing.

In respect of Table 4.10 (see APPENDIX D), the relationship between base station locations and LTE benefits was discussed as follows: The correlation between base station locations and LTE benefits in terms of speed and capacity was $r = -1$. The relationship between the variables was weak. Hence the correlation was insignificant due to the fact that the data sample was small. In actuality, it was however common sense that the area with more base stations stands a chance of improved connectivity service features.

Corresponding to Table 4.11 (see APPENDIX D), the relationship between power consumed by a typical base station and area most located with electricity equipment was discussed as follows: The power consumed by a typical base station was on average 1.5 kilowatts. In view of power consumed, it was notable that Nampower holds most of its electrical infrastructure in urban areas (O. Hekandjo, personal communication, April 24, 2014). This meant that most of the power availability was in the urban areas. The correlation between the two

variables, power consumed and infrastructure locations was technically negative at r = -1. The relationship was weak, hence the result was insignificant. In reality however, the more the power availability, the more connectivity services were enabled. Infrastructure extension to the remote areas would require more power, yet it would enable growth and connectivity services for those places, especially in connecting students to sponsors.

The sentiment that most infrastructure was located in urban areas was supported by Press (2004), who stated that there was virtually no connectivity in rural villages of developing nations. He noted that there was already fiber connectivity in most large urban areas, but rural backhaul was difficult in developing nations. The author further identified those villages in remote locations, and the infrastructure that facilitated the construction of backhaul cables in developed nations such as roads, railroads, pipelines — was poor or non–existent. In support of Press, Brewer (2005) noted that rural life in the least developed countries could be defined in part by the absence of much infrastructure. He claimed that transportation, electricity, water, and communication infrastructures were generally limited to urban areas. Hence, the ACRCF needed to deliberate on meeting the infrastructure gap between the rural and urban areas. If the remote infrastructure was utilised optimally, then similar benefits to those in the urban locale could also be reaped by the rural areas.

4.3 Technical considerations

The use of Long Term Evolution (LTE) to provide coverage was useful because the technology was much cheaper and more flexible to upgrade than the previous infrastructure (S. Duncan, personal communication, April 7, 2014). In another interview, D. Musvamirhi (personal communication, April 20, 2014) said that LTE come in common wavelengths of one thousand eight hundred (1800) MHz and nine hundred (900) MHz. He further noted that in some remote areas, the people were not accessible due to low lying area. He said they had to come to areas of relative flatness (flat terrain) to access and be contacted through the technology services. In contrast, the ACRCF with the use of boosters allowed the remote schools in those low lying areas to receive connectivity. Hence, low lying terrain would be a non-issue with the ACRCF in terms of providing connectivity services to the students in remote areas.

According to D. Musvamirhi (personal communication, January 1, 2012), service to reach the remote students utilising base stations were affected by a number of circumstances such as: grade of service, density of people, model of base station, and distance of reach. He said base stations in Namibia have a reach of about thirty-two (32) kilometres for effective service. He emphasised that in total, sixty (60) kilometres, could be the distance between two base stations' radius power. Hence, a bigger buffer would be needed to increase distance between two base stations. The ACRCF would require Government regulation that would push sponsors to overlook density of population in a location, yet consider distance of reach for the required students. The initiative would be focused on future benefits

of the communities participating, and not for instant monetary returns, especially for the ISPs. The ACRCF would as well utilise boosters to increase the distance and reach of the connectivity service towards the respective schools.

Further from the interviewee, the researcher noted that other than distance, timing advance was also a limiting factor. He said that those in remote areas could be in an area with less than fifteen (15) kilometres, yet have no coverage. In addition, he stated that repeaters could be used in such an instance for the reception of line of sight for them. This study, however, proposes the use of boosters to connect the remote schools through the ACRCF. ACRCF connectivity boosters would provide directed linking of wavelengths from the eNodeBs to the schools and from the institutions back to the base stations. The signals would be sorted at the parastatal telecommunication's (ISP) central processing server.

In effect, the general cost of a base station can be about N$ 1.5 million – N$ 2 million. Due to rural electrification it would however become cheaper to setup a base station (S. Duncan, personal communication, April 7, 2014). The entities setting up the nodes would not have to push the power service utility providers, for instance Nampower, to divert electricity to regions where the power was not available. The fact that electricity would be available to those locations would enable the cost to be affordable for the service providers. Different brands of base station and connectivity equipment would however have diverse costs, hence the need to assess the expenditure.

4.4 In summary

Connectivity to remote areas was noted by respondents to improve the scholarship awarding process. Infrastructure setup is not cheap, but through a stakeholder consortium affordability could come in for the benefit of the student from remote areas to receive scholarships through ACRCF connectivity services.

5. ACRCF ARCHITECTURE

The purpose of this chapter is to explain the proposed architecture that could be adopted in bridging the rural urban barriers in terms of scholarship awarding. The chapter discusses the proposed framework that would facilitate improved communications to allow the sponsors to reach the students timeously.

The ACRCF was a concept to improve communications between the sponsors and rural students as the manual systems in place have needed to be supported by technology. The conception of the ACRCF architecture endeavoured to ensure inclusivity for remote areas of Namibia to also take part in the benefits of the urban, and in this case, in terms of scholarship awarding.

5.1 The Conceptual Framework Model

The conceptual framework model would be the underlying basis of the ACRCF. The framework would be regulated by a body of governmental and non-governmental stakeholders. Entities involved would include sponsors, regulatory bodies such as Communications Regulatory Authority of Namibia (CRAN), Ministry of Information and Communications Technology, and the Ministry of Education. The regulatory authorities would ensure that the ACRCF adheres to national standards for information technology communications. The authorities involved would be able to monitor the participation of the sponsors in contributing to the community development ACRCF initiative for the benefit of remote students.

Below is the conceptual model of the ACRCF:

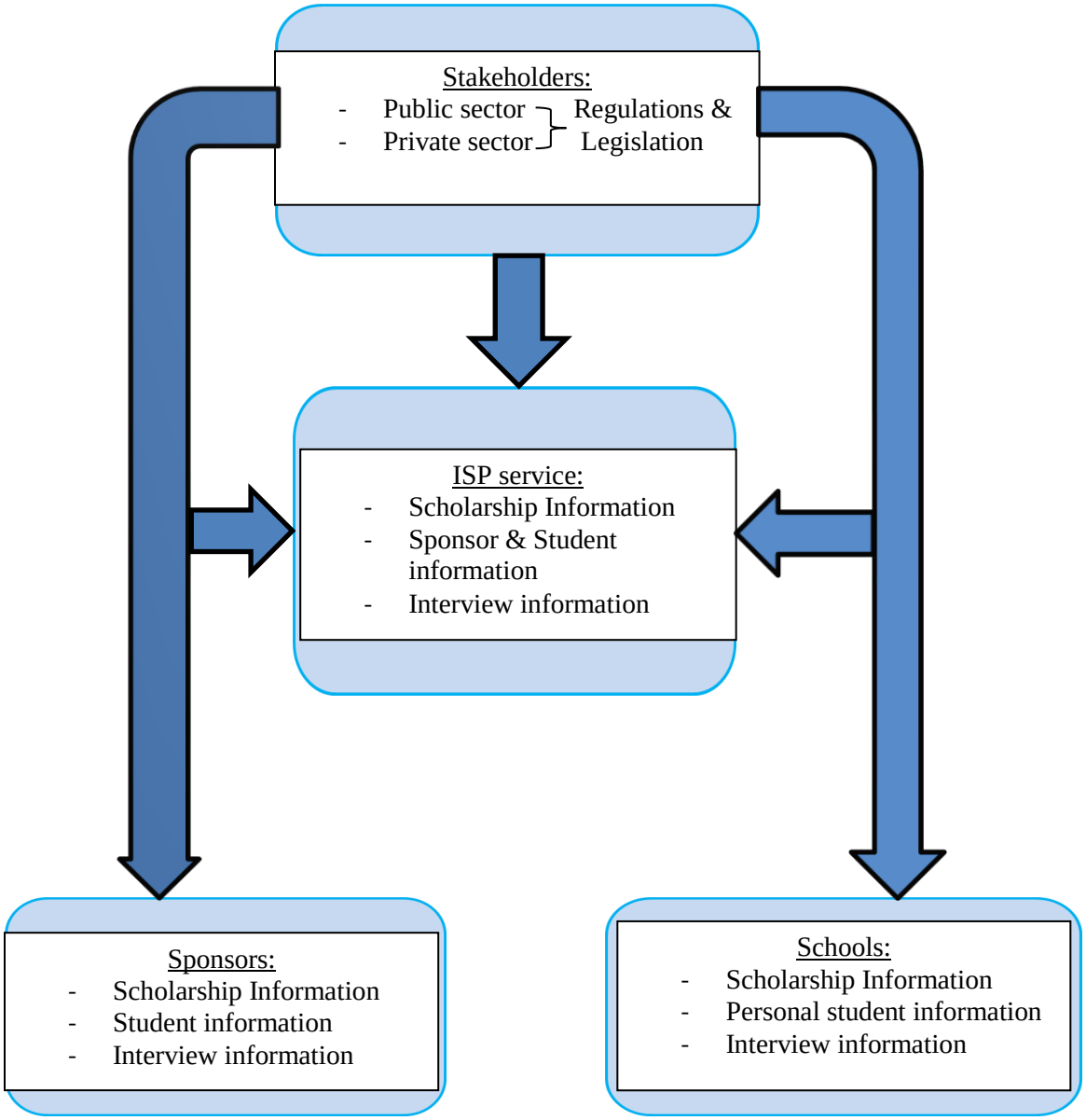

Figure 5.1 Access Coverage Remote Connectivity Framework Model (ACRCFM)

The Internet Service Providers (ISP) would be responsible for the provision of data integrity for the ACRCF. Authentication and authorisation principles would have to be in place. The ISP would provide cloud services for data storage and retrieval for both the sponsors and prospective students at the schools involved.

Sponsors would be able to set psychometric tests for testing the aptitude of the students on the web browser. The students would be able to take the tests online and the results would be sent to the sponsors via the ACRCF API. The sponsors would be able to upload scholarship and interview information as well as to view student information.

Students at respective schools would be able to view scholarship and interview information on the web browser. The students would be able to contact the sponsors through the ACRCF API in order to provide their scholarship choices for the respective companies involved.

5.2 Digitally Divide Conceptual Model

Figure 5.2 refers to the Digital Divide Conceptual Model (DDCM) which was the conceived setting in absence of the ACRCF. The DDCM focused on the urban areas and the students in such resource rich locations, yet it did not cater for the poor connectivity infrastructure lacking in remote parts of the country.

The previous setting model in resource reach for those at the villages or remote places was depicted as below:

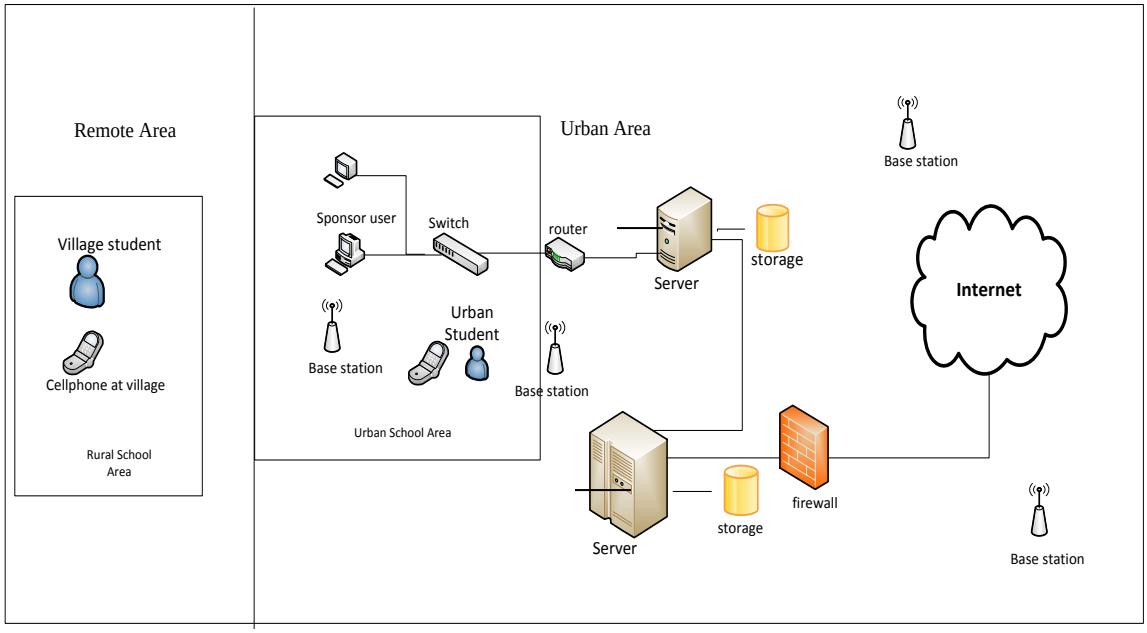

Figure 5.2 Digital Divide Conceptual Model: Rural and Urban Area Infrastructure

The Digital Divide Conceptual Model (DDCM) in Figure 5.2 depicted the situation of poor connectivity reach to rural students. The village student at a remote school, even though they might be fortunate to have a cellphone, most often not, that they got from the city, will still be isolated from connectivity. All connectivity resources in this DDCM were in the city.

As depicted in Figure 5.2, the village was isolated from connectivity due to poor resource supply in such areas. The users in the city, which were the urban students, had all the resources such that they had connections even to Internet and cellphone networks at their convenience time. Images of the connected urban

schools are depicted in APPENDIX E. The remote schools were not represented on google due to lack of connectivity to those schools.

5.3 ACRCF for the Namibian Setting

The ACRCF setting in resource reach for those at the villages or remote places was depicted in Figure 5.3:

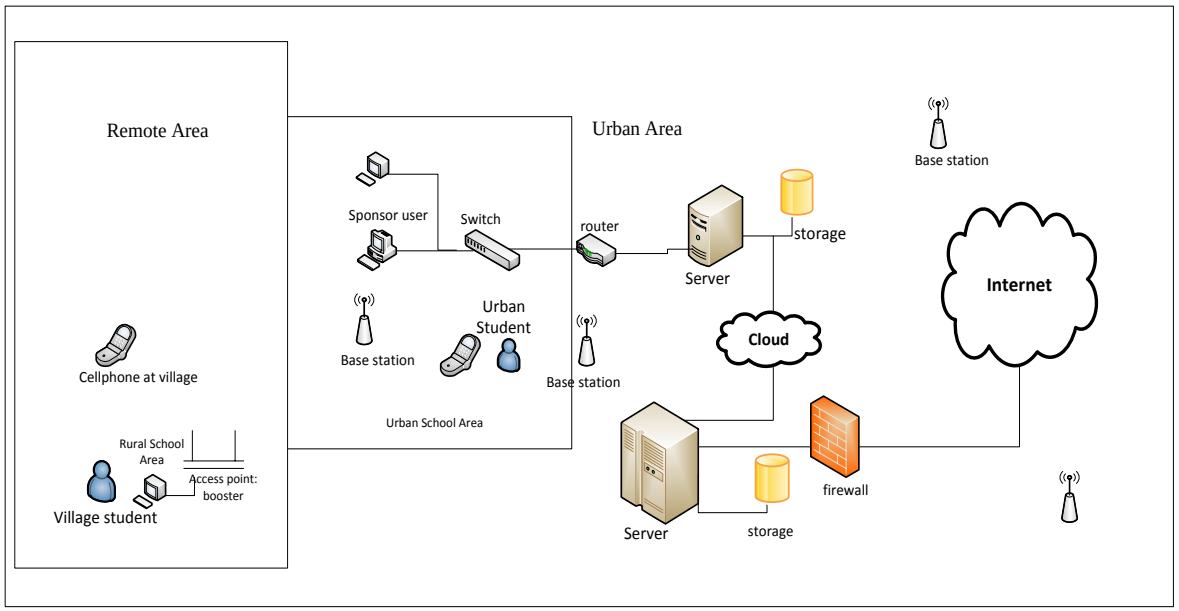

Figure 5.3 Access Coverage for Remote Connectivity Framework (ACRCF)

Figure 5.3 represented the ACRCF architecture for reaching students in remote areas for scholarships. In that architecture, the base stations as well as access points had to be placed strategically to reach the remote areas. The formula for signal reuse was represented as follows: Distance (D) = Cell Radius (R) [√3Number of cells (N)]. Signal reuse and coverage area would have to be considered were the infrastructure placement was difficult.

The framework sections were divided into urban and remote, as such connectivity reach was ensured for both places. . In the architecture, the boosters ensured a connectivity signal was present for the terminal at the remote school to access the Internet, hence providing a link between the students and sponsors.

Figure 5.4 LTE base station

Figure 5.5 Booster

The eNodeB was the LTE base station (see Figure 5.4) that was placed in a most opportune spot for best maximum network coverage to include the disadvantaged community. As demonstrated in the Figure 6.3, through the ACRCF platform a student could make a call from his phone due to network provision through eNodeB. The rural student was also able to access connectivity service through

their smart phone or through a computer workstation at the institution in the remote area. The ACRCF connectivity would be enhanced by boosters (see Figure 5.5).

As denoted in Figure 5.3, the computer workstations at the remote schools would provide an interface for sponsors to interact with students. Student data would be entered at the workstations from the schools and received by the sponsors for scholarship processing.

The workstations could be connected in various ways depending on network set up at respective schools or sponsor sites. However, a definite layout would be provided to ensure that there was connection to a router which would be connected to network of eNodeBs that would reach cloud servers at the ISP. The router can be used to connect multiple local area networks to the cloud. The specific router that would be useful in this case was a broadband router that had both, Dynamic Host Control Protocol (DHCP), and firewall capabilities.

LTE technology with its cost effectiveness was proposed to be utilized in the ACRCF. LTE eNodeBs (base stations) would be setup as they had a faster downlink to ensure that the needy student in the remote location was reached by their sponsor.

The ISPs server catered for processing of application data which was stored in their storage server and routed to the terminals. The terminals had the basic data interface for entering data at the various schools.

The Cloud as a Service infrastructure displayed the inclusiveness of the remote area into the network supported via Long Term Evolution (LTE) for the benefit of the learners and stakeholders involved in sponsoring. Access Controllers would have to be applied to regulate access to the network cloud by authenticating and authorising users based on stakeholder subscription to the initiative.

5.4 ACRCF Application Programming Interface (API)

The API snippets below provided an insight into the workings of the ACRCF communications tools between the remote schools and the sponsors.

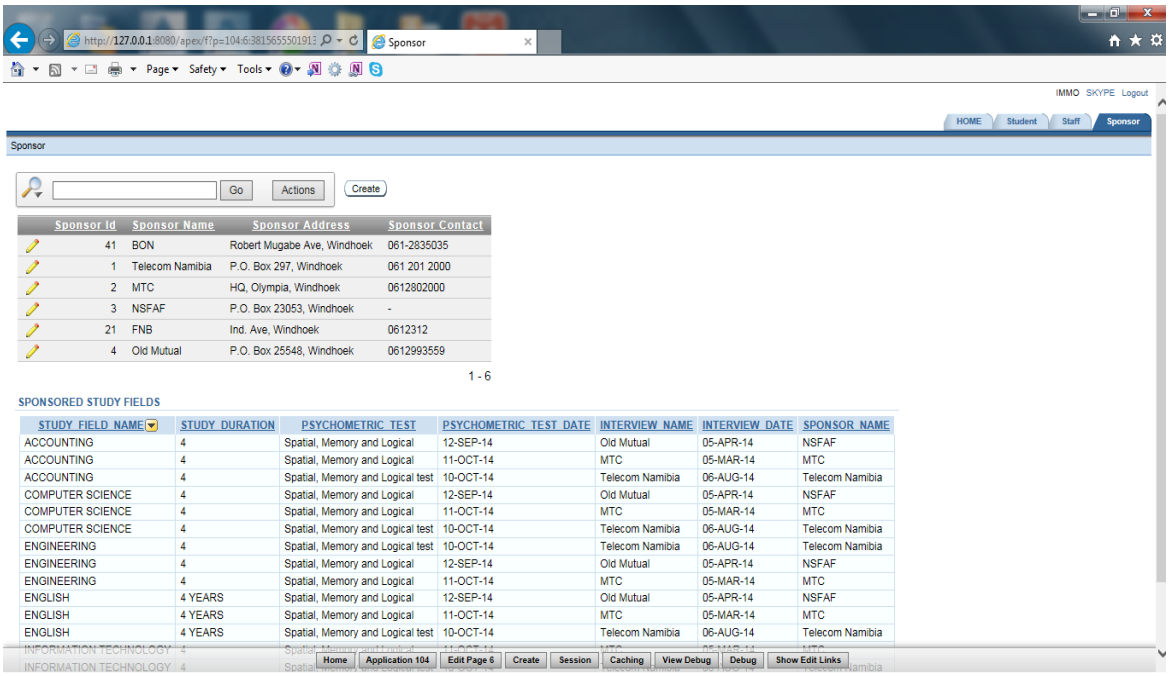

Figure 5.6: API Sponsor Information

The sponsor information screen (see Figure 6.6) showed the sponsors that would be involved in the ACRCF initiative the remote student data such as the study fields and dates for interviews.

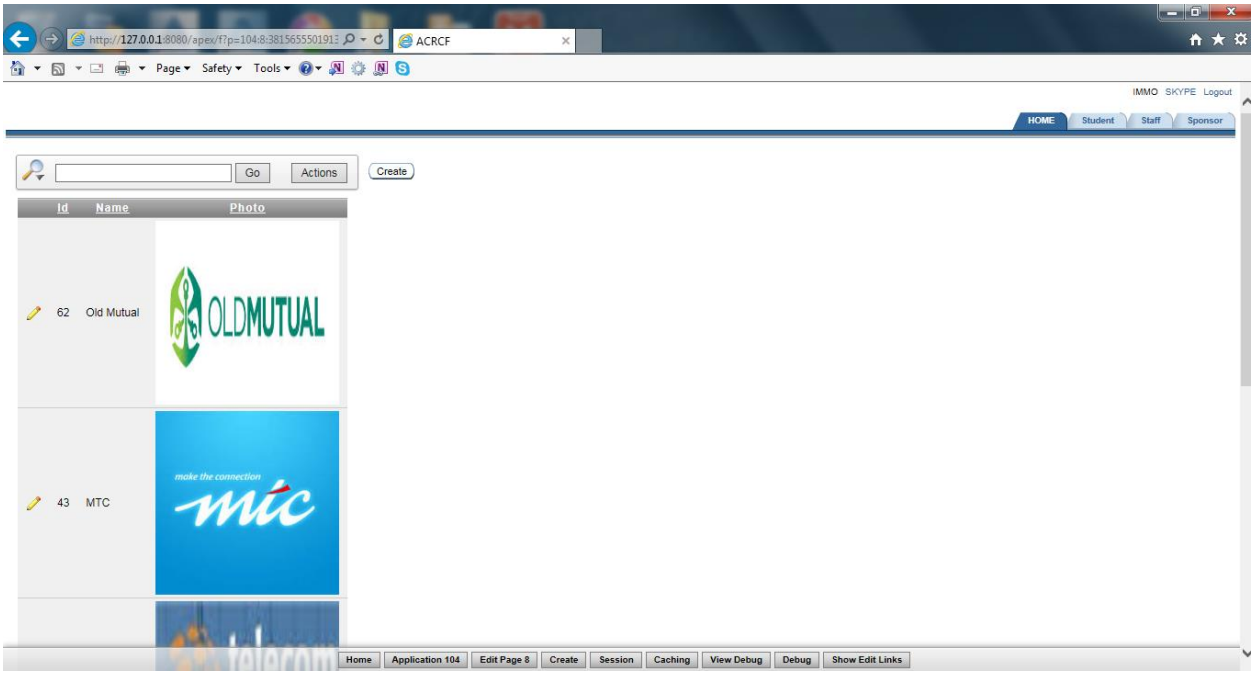

Figure 5.7: API Sponsor Logo Screen

The home button (see Figure 6.7) contained information on various sponsors and their company themes or logos.

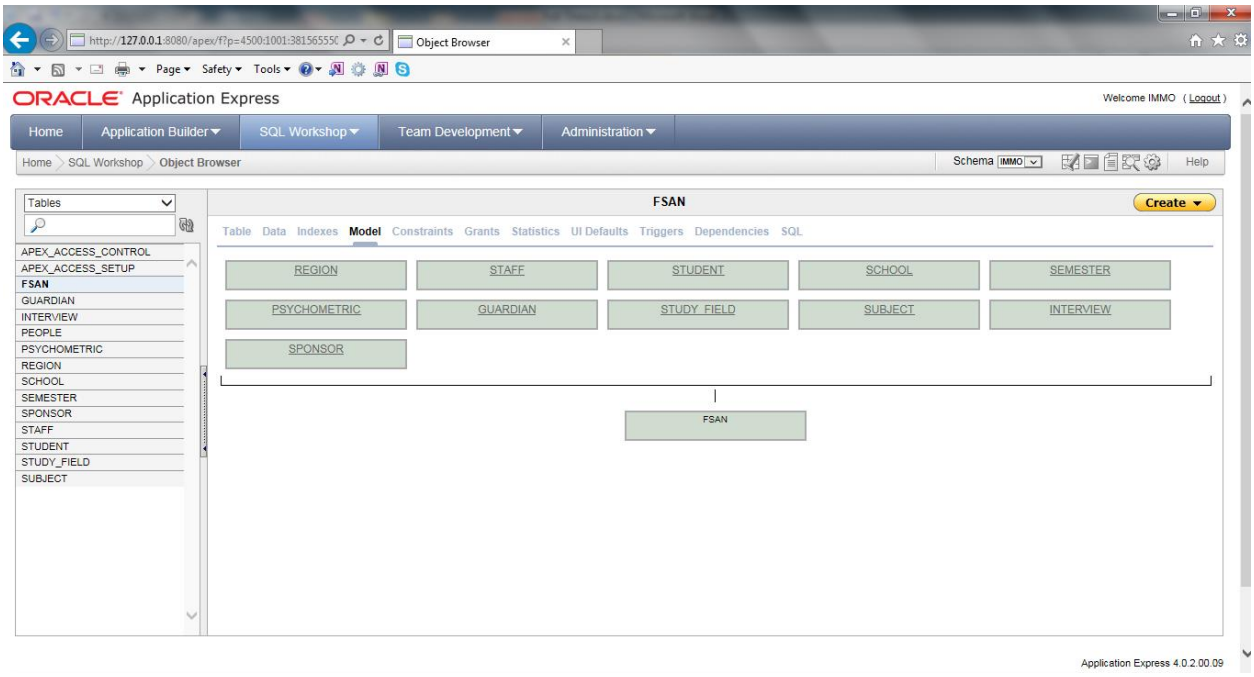

Figure 5.8: ACRCF API Information Tables

The ACRCF API was linked to a database which consisted of information about regions, staff, students, schools, and sponsor data. The tables in Figure 6.8 depicted the data contained in the database.

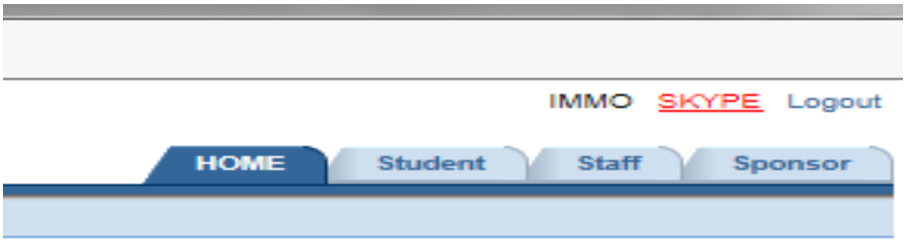

Figure 5.9: API demo VoiP service link

The VoiP link (see Figure 6.9) provided an interface for the sponsor to communicate with the remote students face to face over the network connection.

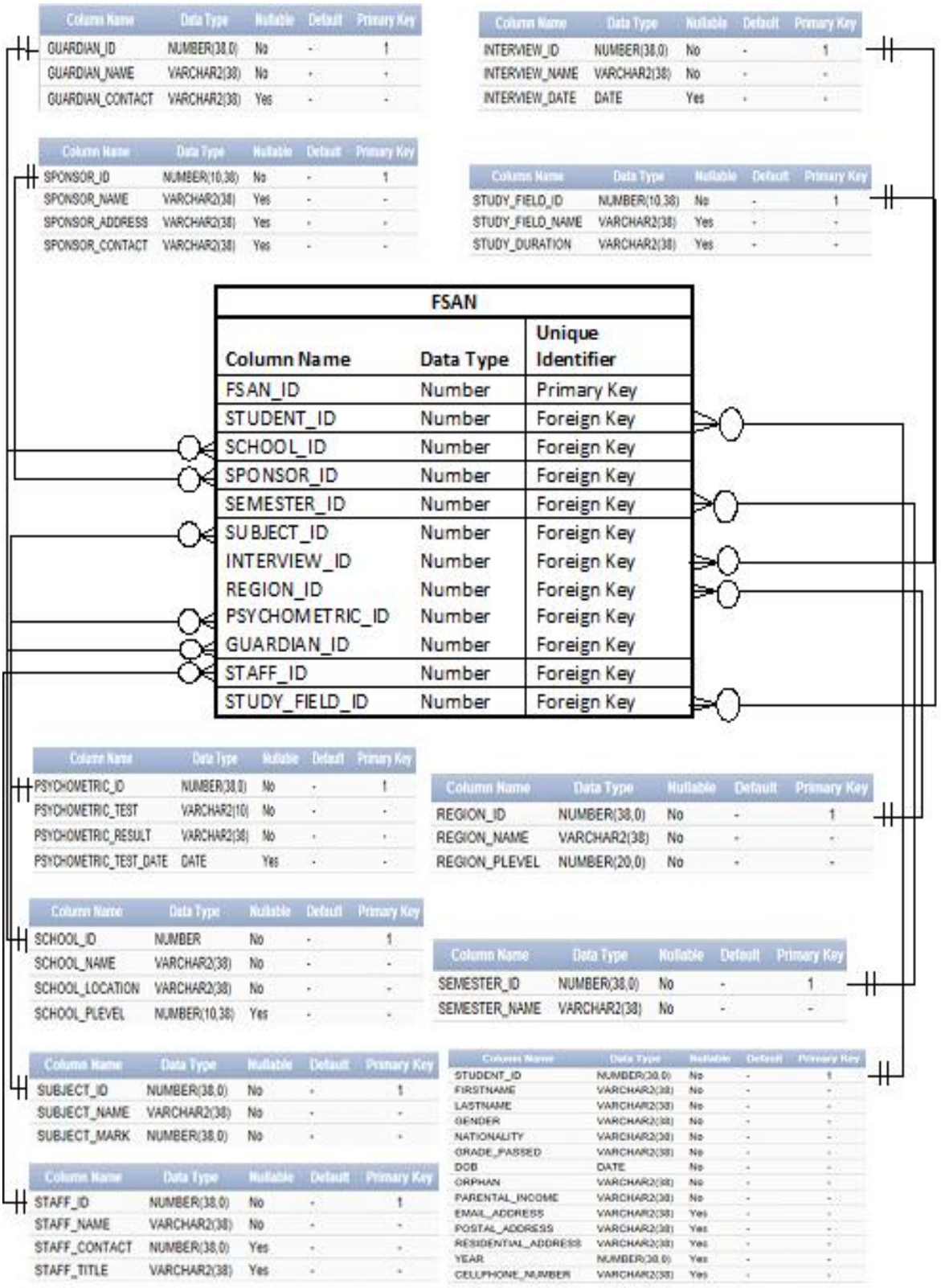

Figure 5.10: ACRCF ER-Diagram

Note: The primary keys in the ACRCF ER-diagram are linked to one another through a connecting table (FSAN).

ACRCF API Tables Code (see APPENDIX H)

```
CREATE TABLE  "FSAN"
        (       "FSAN_ID" NUMBER(38,0) NOT NULL ENABLE,
"FIRSTNAME" VARCHAR2(38) NOT NULL ENABLE,
"LASTNAME" VARCHAR2(38) NOT NULL ENABLE,
"GENDER" VARCHAR2(30) NOT NULL ENABLE,
"NATIONALITY" VARCHAR2(38) NOT NULL ENABLE,
"GRADE_PASSED" NUMBER(38,0) NOT NULL ENABLE,
"DOB" DATE NOT NULL ENABLE,
"ORPHAN" CHAR(4) NOT NULL ENABLE,
"PARENTAL_INCOME" VARCHAR2(38) NOT NULL ENABLE,
"EMAIL_ADDRESS" VARCHAR2(38) NOT NULL ENABLE,
"POSTAL_ADDRESS" VARCHAR2(38) NOT NULL ENABLE,
"RESIDENTIAL_ADDRESS" VARCHAR2(38) NOT NULL ENABLE,
"YEAR" NUMBER(6,0) NOT NULL ENABLE,
"CELLPHONE_NUMBER" NUMBER(38,0) NOT NULL ENABLE,
"GUARDIAN_NAME" VARCHAR2(38) NOT NULL ENABLE,
"INTERVIEW_NAME" VARCHAR2(38) NOT NULL ENABLE,
"INTERVIEW_DATE" DATE NOT NULL ENABLE,
"SUBJECT_NAME" VARCHAR2(38) NOT NULL ENABLE,
"SUBJECT_MARK" VARCHAR2(38) NOT NULL ENABLE,
"PSYCHOMETRIC_TEST" VARCHAR2(38) NOT NULL ENABLE,
"PSYCHOMETRIC_RESULT" VARCHAR2(38) NOT NULL ENABLE,
"GUARDIAN_CONTACT" NUMBER(38,0) NOT NULL ENABLE,
"STAFF_NAME" VARCHAR2(38) NOT NULL ENABLE,
"STAFF_CONTACT" NUMBER(38,0),
"SPONSOR_ID" NUMBER(10,38),
"SPONSOR_NAME" VARCHAR2(38),
"SPONSOR_ADDRESS" VARCHAR2(38),
"SPONSOR_CONTACT" NUMBER(12,38),
"STUDY_DURATION" VARCHAR2(38),
"GUARDIAN_ID" NUMBER(10,38),
"INTERVIEW_ID" NUMBER(10,38),
"PSYCHOMETRIC_ID" NUMBER(10,38),
"PSYCHOMETRIC_TEST_DATE" DATE,
"REGION_ID" NUMBER(10,38),
"SCHOOL_ID" NUMBER(10,38),
"REGION_NAME" VARCHAR2(38),
"REGION_PLEVEL" NUMBER(10,38),
"SCHOOL_NAME" VARCHAR2(38),
"SCHOOL_LOCATION" VARCHAR2(38),
"SCHOOL_PLEVEL" NUMBER(10,38),
"SEMESTER_ID" NUMBER(10,38),
"SEMESTER_NAME" VARCHAR2(38),
"STAFF_ID" NUMBER(10,38),
"STAFF_TITLE" VARCHAR2(38),
"STUDENT_ID" NUMBER(10,38),
```

```
"SUBJECT_ID" NUMBER(10,38),
"STUDY_FIELD_ID" NUMBER(38,0),
 CONSTRAINT "FSAN_PK" PRIMARY KEY ("FSAN_ID") ENABLE
  ) ;ALTER TABLE  "FSAN" ADD CONSTRAINT "GUARDIAN_FK" FOREIGN KEY
("GUARDIAN_ID")
 REFERENCES  "GUARDIAN" ("GUARDIAN_ID") ENABLE;ALTER TABLE  "FSAN"
ADD CONSTRAINT "INTERVIEW_FK" FOREIGN KEY ("INTERVIEW_ID")
 REFERENCES  "INTERVIEW" ("INTERVIEW_ID") ENABLE;ALTER TABLE  "FSAN"
ADD CONSTRAINT "PSYCHOMETRIC_FK" FOREIGN KEY ("PSYCHOMETRIC_ID")
 REFERENCES  "PSYCHOMETRIC" ("PSYCHOMETRIC_ID") ENABLE;ALTER TABLE
"FSAN" ADD CONSTRAINT "REGION_ID" FOREIGN KEY ("REGION_ID")
 REFERENCES  "REGION" ("REGION_ID") ENABLE;ALTER TABLE  "FSAN" ADD
CONSTRAINT "SCHOOL_FK" FOREIGN KEY ("SCHOOL_ID")
 REFERENCES  "SCHOOL" ("SCHOOL_ID") ENABLE;ALTER TABLE  "FSAN" ADD
CONSTRAINT "SEMESTER_FK" FOREIGN KEY ("SEMESTER_ID")
 REFERENCES  "SEMESTER" ("SEMESTER_ID") ENABLE;ALTER TABLE  "FSAN"
ADD CONSTRAINT "SPONSOR_ID" FOREIGN KEY ("SPONSOR_ID")
 REFERENCES  "SPONSOR" ("SPONSOR_ID") ENABLE;ALTER TABLE  "FSAN" ADD
CONSTRAINT "STAFF_FK" FOREIGN KEY ("STAFF_ID")
 REFERENCES  "STAFF" ("STAFF_ID") ENABLE;ALTER TABLE  "FSAN" ADD
"STUDENT_FK" FOREIGN KEY ("STUDENT_ID")
 REFERENCES  "STUDENT" ("STUDENT_ID") ENABLE;ALTER TABLE  "FSAN" ADD
CONSTRAINT "STUDY_FIELD_ID_FK" FOREIGN KEY ("STUDY_FIELD_ID")
 REFERENCES  "STUDY_FIELD" ("STUDY_FIELD_ID") ENABLE;ALTER TABLE
"FSAN" ADD CONSTRAINT "SUBJECT_FK" FOREIGN KEY ("SUBJECT_ID")
```

The code snippet above was used to create the tables for the various elements in the ACRCF database such as region, staff, student, school, semester, interview, psychometric, study field, guardian, subject and sponsor. The named objects are then linked to one another according to the specification requirements under the ACRCF.

5.5 In Summary

The ACRCF was conceived to supplement the DDCM that had been excluding the remote areas from connectivity. Further, the framework had been envisioned to provide proficient service delivery to the remote areas in the wake of the arrival of the West African Cable System (WACS). Henceforth, the initiative caters to

link the sponsors to their prospective remote scholarship recipients with consideration of shadowing pitfalls.

6. CONCLUSIONS AND RECOMMENDATIONS

The chapter endeavours to answer the research questions with the conclusions drawn from the findings. The chapter concludes the work by providing relevant conclusions and recommendations for further research.

6.1 Conclusions

The study aimed to improve scholarship awarding within the borders of Namibia via the envisaged implementation of the ACRCF. The research focused on addressing the inequalities that existed between the rural and urban areas in terms of linking the sponsors to their preferred student scholarship recipients.

Research question 1: *How can access to connectivity in remote schools be improved to facilitate equitable scholarship awarding amongst learners in Namibia?*

Connectivity access to remote schools could be improved through the ACRCF, which would link the remote as well as urban schools. The ACRCF would utilise Cloud as a Service technologies for data storage to be readily available to stakeholders.

Research question 2: *What can LTE connectivity contribute towards the improvement of communication between sponsors and remote schools?*

The use of Long Term Evolution (LTE) technology would ensure users experience low latency, high data peak rates, and backwards compatibility with previous technologies such as UMTS, CDMA and GSM (D. Musvamirhi, personal communication, April 20, 2014). The use of VoiP applications embedded in the ACRCF system would enable sponsors to video conference with the remote students for interviews. Hence, the sponsors would be able to reach the remote students with more confidence as the network speed and capacity would be able to handle streaming traffic seamlessly.

Research question 3: *What measures can be used to promote fairness in scholarship awarding amongst remote and urban area students?*

The ACRCF would provide a levelled connection field for the remote and urban area school students to access scholarship information as both groups become reachable equitably by sponsors. The surety that the remote area schools would be connected to the sponsors through the ACRCF technologies was in itself a measure to ensure fairness in scholarship awarding. The framework system would evaluate the candidate beyond grades even though academic performance is highly regarded amongst sponsors (see Figure 4.7).

In conclusion, the research considered providing a more improved, secure, standardised system of infrastructure for student selection. The study deliberated on information provision and maintenance, sponsor to student communications

and vice versa. The deployment of ACRCF would surely assist both Government and non-governmental entities involved in the selection of candidates for scholarships and grants for further study at institutions of higher learning.

6.2 Recommendations

In respects to the bridging the ‘digital divide’ between the rural and urban areas, it was evident from this research that more work needed to be done in order to bring about equality in services. Stakeholders from both the private sector and Government would need to be involved in order to provide a more holistic solution. Moreover, with innovation and solutions, comes the need for counter measures such as security of the new communicative cyber environments. However, it was recommendable that researchers looked for solutions on best practices to implement on connecting the remote communities with more improved technologies to LTE. This research has provided data that showed that improved communications have enhanced lives of rural communities. Hence, there would be a need to encourage more researchers to provide smarter technological methods to bridge information reach gaps in society.

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APPENDIX A: Questionnaire

Research Topic: Access Coverage for Remote Connectivity Framework (ACRCF): Facilitating Scholarship Awarding in Namibia

The purpose of this questionnaire is to help collect data for the study.
Tick where appropriate and write your responses in the spaces provided.

***NB**: Information provided in this questionnaire will be treated with anonymity and confidentiality.*

Section A: Demographic Variables *(Put a tick ("√") in the right box)*

1. Gender: Male ☐ Female ☐
2. Age: 16-21 ☐ 22-30 ☐ 31-40 ☐ 41-50 ☐ 51+ ☐
3. Group: Parastatal entity ☐ Ministry ☐ Private company ☐ Students ☐ Public ☐

4. Region: ……

(For section B and C: please ensure you respond to section that pertains to you)

Section B: Comparisons of Remote and Urban Areas by Sponsoring Entities (Parastatal/Ministry/Private Company)

Key: *Remote Area: RA;* *Urban Area: UA*

1. Do you have any statistics on student passing rates in remote areas vs. those in urban areas?
   Yes ☐ or No ☐

2. If **Yes**, which group has a low pass rate? RA ☐ or UA ☐

3. If you ticked **Yes** √ in question 1, what is the percentage pass rate of remote area students vs. urban area students? (*Tick the right % boxes in the table below):*

Remote Area (RA) Students	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Urban Area (UA) Students	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

4. What criteria do you use to select students for scholarships? *(Tick/fill where applicable):*

   Location ☐ Population group ☐ Grades ☐ Applications handed in ☐ Parental income ☐

   Other (specify): ……

5. Which group has been difficult to connect to/reach? RA ☐ or UA ☐

6. If you ticked **Yes** √ in question 1, Which group received most scholarships or grants? (*Tick your response per year*)

2010 RA ☐ or UA ☐ 2011 RA ☐ or UA ☐ 2012 RA ☐ or UA ☐ 2013 RA ☐ or UA ☐

7. How many **RA** students received grants from your institution? *(Enter figure for each year in box):*
2010 ☐ 2011 ☐ 2012 ☐ 2013 ☐

8. If **RA** received less grants, will connectivity improve the situation? Yes ☐ or No ☐

9. What factors do you think cause the group with low financial assistance not to receive grants? *(Tick/fill where applicable):*
Poor Connectivity ☐ Distance from resources ☐ Lack of information ☐

Other (specify): ……

Section C: Comparisons of Remote and Urban Areas by the Public and Students

1. Which group do you think receives more grants or scholarships? RA ☐ or UA ☐

2. What factors do you think cause the group with low financial assistance to miss out on grants? *(Tick/fill where applicable):*
Poor Connectivity ☐ Distance from resources ☐ Lack of information ☐

Other (specify): ……

3. Are you from a RA or UA school? RA ☐ or UA ☐

4. Do you have access to connectivity services (eg. Internet) at your school?
Yes ☐ or No ☐

5. If **No,** why do you think there is no connectivity? No sponsors ☐ No public awareness ☐ No idea ☐

6. Will connectivity be useful in the assistance of **RA** students in getting funding from donors?
Yes ☐ or No ☐

7. If **Yes**, how will RA students benefit from the connectivity? *(Tick/fill where applicable):*
Improved funding ☐ Better grades ☐

Other (specify): …….

8. Which group has a low pass rate? RA ☐ or UA ☐

9. If you ticked **RA** √ in question 8 above as having a low pass rate, give a reason why?_____

Thank you very much for taking time to complete this questionnaire. For any queries contact:

Mr. I. Ndiwakalunga at cell: 0812194281 or iombili@gmail.com Supervisor: Prof. J. Mbale
jmbale@unam.na

APPENDIX B: Interview guideline: Telecommmunications Engineers & Human Resource

Interview questions:

Research Topic: Access Coverage for Remote Connectivity Framework (ACRF): Facilitating Scholarship Awarding in Namibia

Section A: Engineers

1. What are some improvements that you notice between the **3G** and

   4G technologies and also in terms of benefits/advantages and disadvantages?

2. Cost of an LTE base station?

3. How many 4G base stations do you have across the country?

4. What are the average distances between these base stations?

5. Are they mostly in remote or in urban areas?

6. What are the costs involved in the purchases of the following: Amplifier, Repeater, Base station?

7. Cost of amplifier?

8. Cost of repeaters?

9. Cost of base station?

10. How much energy does a typical base station consume?

11. What are the typical connectivity ranges for your base stations?

Section B: HR/Bursary Officer/Transformation Consultant

12. How many scholarship/bursary applications did you receive in:

    2010? 2011? 2012? 2013?

13. How many students were selected for sponsorship in those years?

    2010: 2011: 2012: 2013:

14. How long does the average current manual analysis & selection process take?

    1 day 1 week 2 weeks 1 month 2 months & more

15. How much does your company spend on average per year on sponsorships?

Below N$100000 Between N$100000-N$499999 N$500000-N$999999 N$1 million & above

APPENDIX C: Interview guideline: Electrical & Civil Engineers

Interview questions:

Research Topic: Access Coverage for Remote Connectivity Framework (ACRF): Facilitating Scholarship Awarding in Namibia

Electrification:

1. How is the electrification spread across the country?

2. What are the benefits of electrification?

3. Does electrification affect Internet accessibility? If so, how?

4. Is your electrification equipment mostly in Urban or Rural areas?

Roads & Construction:

1. What are the benefits of road infrastructures in Urban and Rural areas?

2. How is the proper road system spread across the country?

3. Does the construction of roads affect Internet accessibility? If so, how?

4. Are your proper road systems mainly in Urban or Rural areas?

APPENDIX D: TABLES

Table 4.1: *Correlation between low pass rate and difficult to reach group for MTC*

		If Yes, which group has a low pass rate?	Which group has been difficult to connect to/reach?
If Yes, which group has a low pass rate?	Pearson Correlation	1	.333
	Sig. (2-tailed)		.667
	N	5	4
Which group has been difficult to connect to/reach?	Pearson Correlation	.333	1
	Sig. (2-tailed)	.667	
	N	4	5

Table 4.2: *Correlation between low pass rate and difficult to reach group for NSFAF*

Correlations

		Low pass rate	Difficult reach
Low pass rate	Pearson Correlation	1	1.000**
	Sig. (2-tailed)		.
	N	2	2
Difficult reach	Pearson Correlation	1.000**	1
	Sig. (2-tailed)	.	
	N	2	10

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4.3: *Relationship between lowest pass rate a and difficulty of reach*

	Lowest Pass Rate		**Difficulty of Reach**	
	RA	**UA**	**RA**	**UA**
MTC	2	3	4	1
Telecom	7	4	9	0
Old Mutual	7	0	6	1
NSFAF	4	2	8	1
FNB	2	0	8	0
Sum	22	9	35	3
Mean	4.4	1.8	7	0.6
Variance	6.300000002	3.2	4	0.300000013
St. Deviation	2.50998008	1.788854382	2	0.547722557

Table 4.4: *Relationship between lowest pass rate and criteria of selection*

	Lowest Pass Rate		**Selection Criteria**				
	RA	**UA**	**Grades**	**Location**	**Population group**	**Applications Handed in**	**Parental Income**
MTC	2	3	3	1	0	0	0
Telecom	7	4	6	2	4	4	4
Old Mutual	7	0	5	1	1	0	3
NSFAF	4	2	7	0	0	4	3
FNB	2	0	7	0	0	1	0
Sum	22	9	28	4	5	9	10
Mean	4.4	1.8	3.5	0.8	1	1.8	2
Variance	6.300000002	3.2	8.3125	1.52	17	114	134
St. Deviation	2.509980008	1.788854382	2.883140649	1.232882801	4.123	10.67707825	11.5758369

Table 4.5: *Relationship between connectivity and factors causing low finance to RA*

	Will connectivity improve reach & selection of students		**Factors causing group with low finance support to receive less**				
	Yes	**No**	**Poor Connect-ivity**	**Distance from resources**	**Lack of infor-mation**	**Lack of resources**	**Poor under-standing of requirements**
MTC	2	2	0	3	2	0	0
Telecom	3	2	5	5	8	1	1
Old Mutual	6	0	3	2	5	1	0
NSFAF	4	1	2	4	9	0	0
FNB	5	3	2	4	7	0	2
Sum	20	8	12	18	31	2	3
Mean	4	1.6	2.4	3.6	6.2	0.4	0.6
Variance	2.5	1.3	3.3	1.3	7.7	0.94	0.8
St. Deviation	1.581138 83	1.140175425	1.816590212	1.140175425	2.774887385	0.969535971	0.894427191

Table 4.6: *Relationship between scholarship reception, school location and access to connectivity*

	Scholarship reception		**School location**		**Access to connectivity**	
	RA	**UA**	**RA**	**UA**	**Connectivity**	**No Connectivity**
Academia High School	6	17	1	22	20	3
Windhoek High School	8	11	0	19	18	2
Ambili Combined School	5	15	20	0	1	19
Oshitudha Combined School	1	9	8	2	3	6
Sum	20	52	29	43	42	30
Mean	5	13	7.25	10.75	10.5	7.5
Variance	8.666666667	13.33333333	84.91666667	128.9166667	97.66666667	61.66666667
St. Deviation	2.943920289	3.651483716	9.215023965	11.35414756	9.88264472	7.85281266

Table 4.7: *Relationship between connectivity usefulness and how RA will benefit from connectivity*

	Will connectivity be useful in assisting with funding?		**How RA will benefit from connectivity?**		
	Yes	**No**	**Improved funding**	**Better grades**	**More information**
Academia High School	22	1	13	12	0
Windhoek High School	20	0	3	13	2
Ambili Combined School	20	0	8	11	1
Oshitudha Combined School	10	0	6	4	0
Sum	72	1	30	40	3
Mean	18	0.25	7.5	10	0.75
Variance	29.33333333	0.25	17.66666667	16.66666667	0.916666666
St. Deviation	5.416025603	0.5	4.203173405	4.082482905	0.957427107

Table 4.8: *Relationship between applications received and selection students*

	Applications received				**Selected Students**			
	2010	**2011**	**2012**	**2013**	**2010**	**2011**	**2012**	**2013**
Telecom	252	613	641	336	21	19	14	14
Old Mutual	621	653	713	437	10	10	10	10
Sum	873	1266	1354	773	31	29	24	24
Mean	436.5	633	677	386.5	15.5	14.5	12	12
Variance	68080.5	800	2592	5100.5	60.5	40.5	8	8
St. Deviation	260.922402 3	28.2842712 5	50.9116882 5	71.4177849	7.77817459 3	6.36396103 1	2.8284271 25	2.828427125

Table 4.9: *Relationship between number of base stations and infrastructure costs*

	Number of base stations	**Infrastructure costs**
MTC	60	150000
Telecom	75	120000
Sum	135	270000
Mean	67.5	135000
Variance	112.5	450000000
St. Deviation	10.60660172	21213.20344

Table 4.10: *Relationship between base station locations and LTE benefits*

	Base station locations		**LTE benefits**					
	RA	UA	Faster	More bandwidth	Less frustrations	More capacity	100MB/S	16x better
MTC	0	1	1	1	0	0	1	0
Telecom	0	1	1	1	1	1	1	1
Sum	0	2	2	2	1	1	2	1
Mean	0	1	1	1	0.5	0.5	1	0.5
Variance	0	0	0	0	0.5	0.5	0	0.5
St. Deviation	0	0	0	0	0.707106781	0.707106781	0	0.707106781

Table 4.11: *Relationship between power consumed by typical base station and most electricity equipment locations*

	Power consumed by typical base station	**Electrical equipment locations according to Nampower**	
		RA	UA
MTC	2	0	1
Telecom	1	0	1
Sum	3	0	2
Mean	1.5	0	1
Variance	0.5	0	0
St. Deviation	0.707106781	0	0

APPENDIX E: Connected Schools

Figure E1: Google image of Academia High School

Figure E2: Google image of Windhoek High School

APPENDIX F: Connectivity Tools: LTE panels and Booster

Figure F1: Telecom LTE panels on an eNodeB, Walvis Bay

Figure F2: Booster

Figure F3: Telecom Namibia eNodeB in Pionerspark, Windhoek

APPENDIX G: ACRCF API DEMO

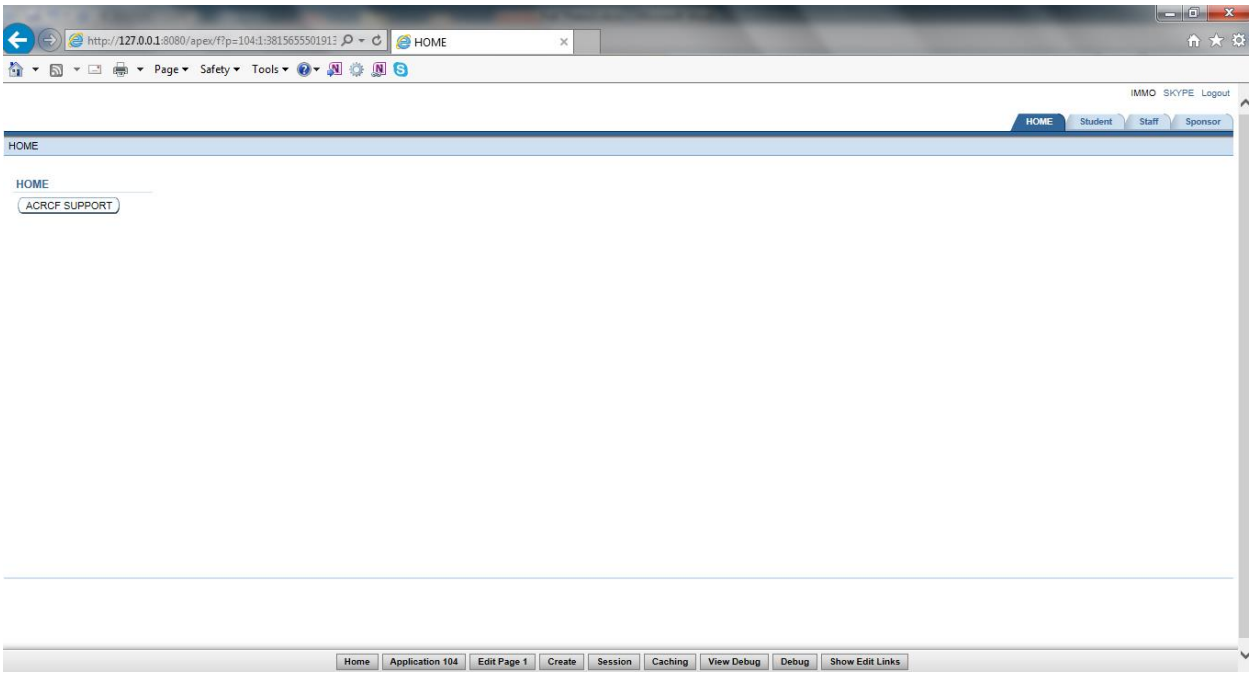

Figure G1: API Home demo screen

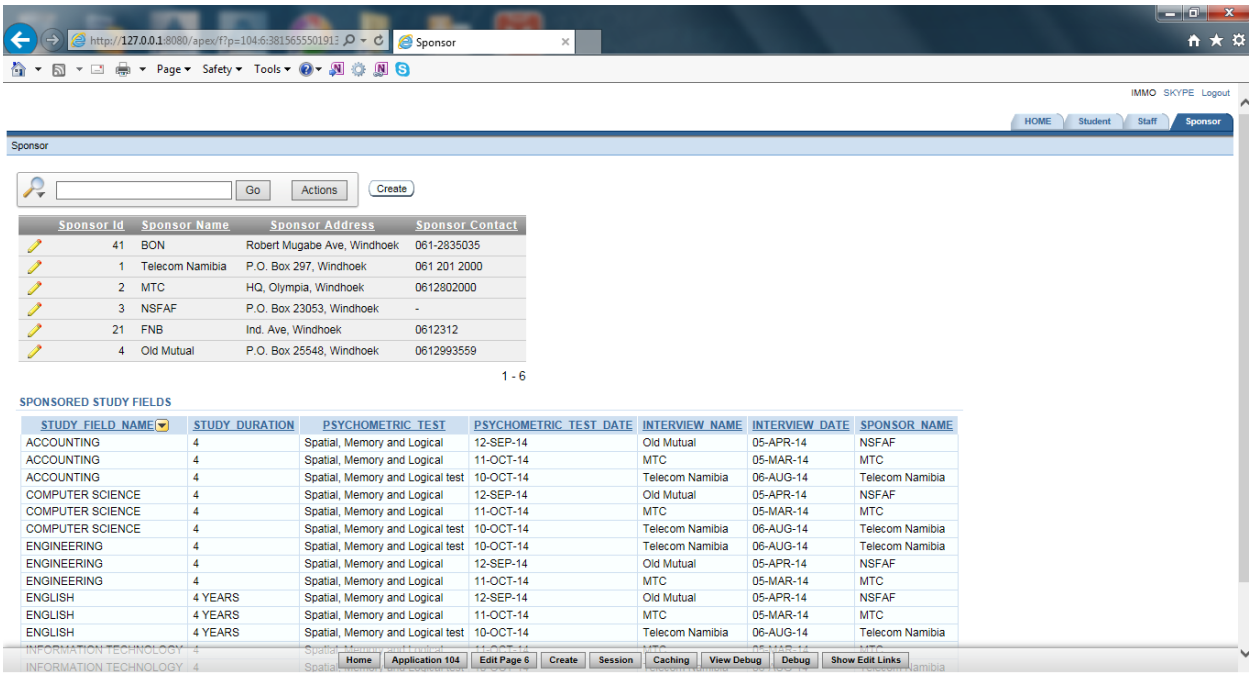

Figure G2: API Sponsor Information demo screen

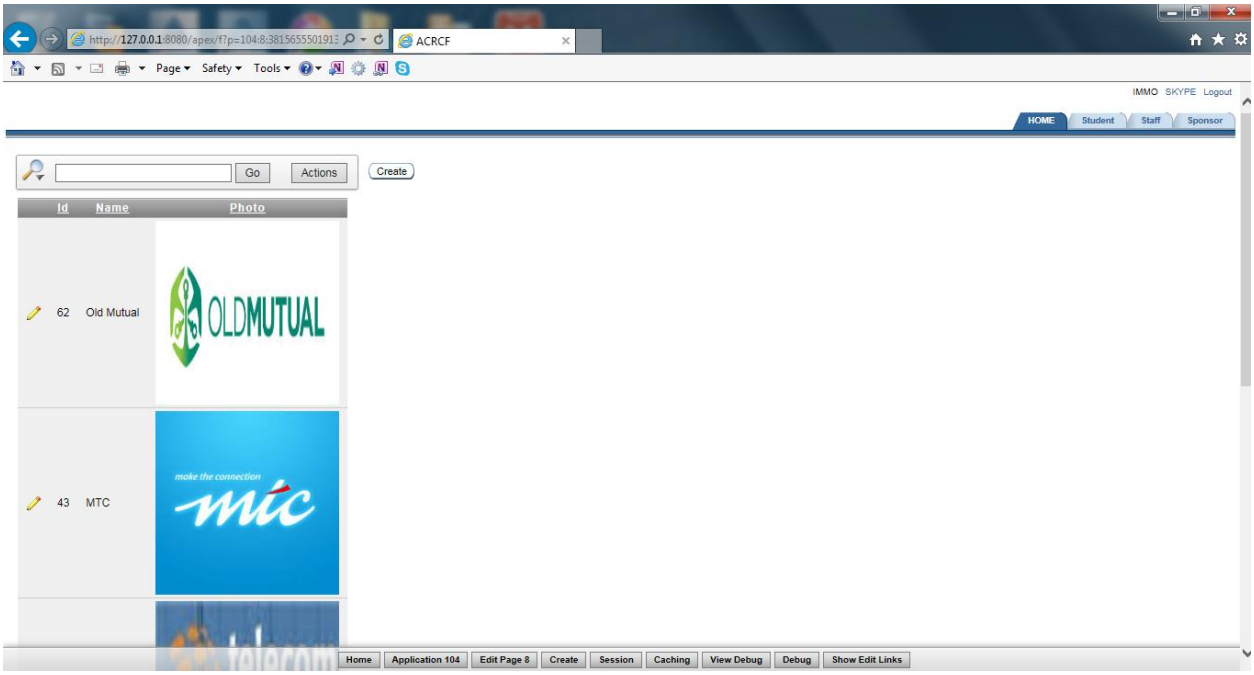

Figure G3: API demo Sponsor logo screen

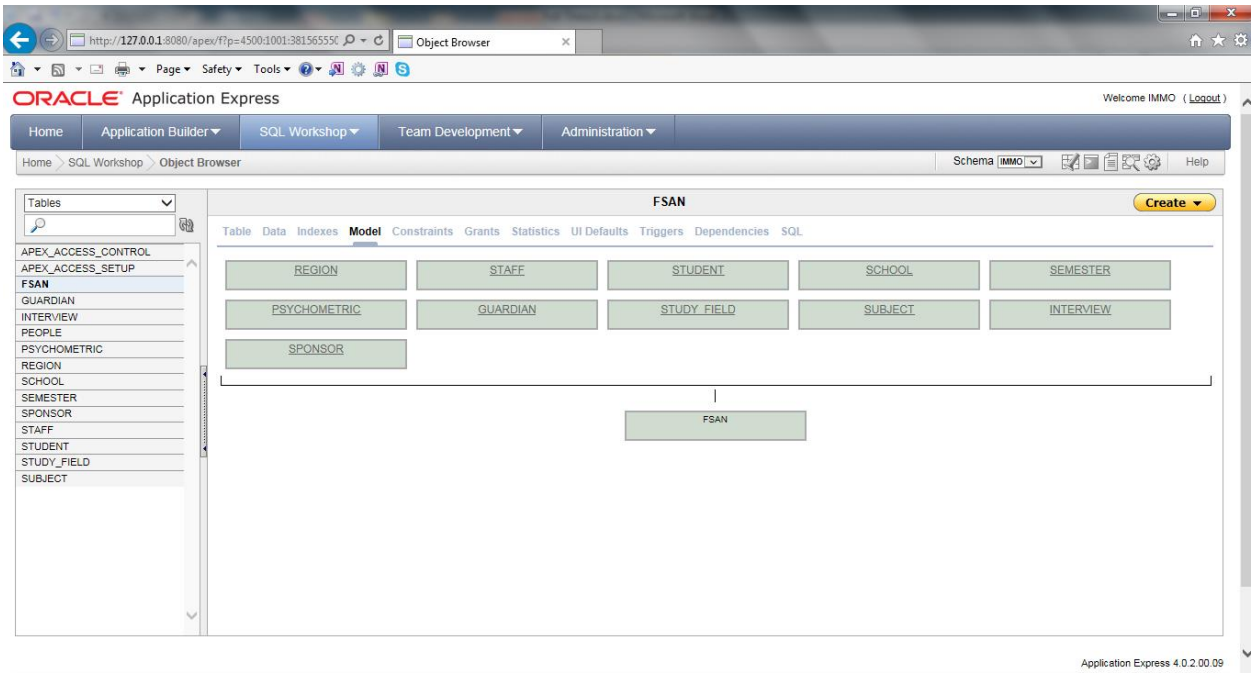

Figure G4: ACRCF API information tables

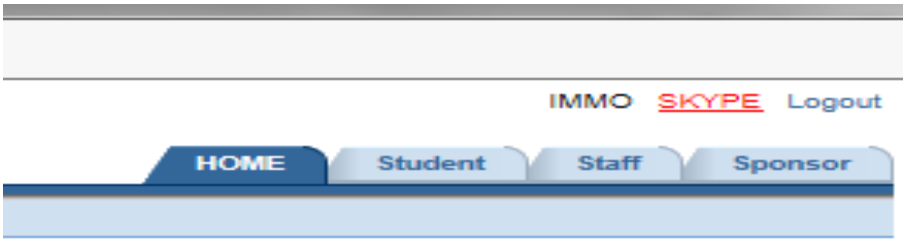

Figure G5: API demo VoiP service link

APPENDIX H: ACRCF API CODE

```
CREATE TABLE  "FSAN"
        (       "FSAN_ID" NUMBER(38,0) NOT NULL ENABLE,
"FIRSTNAME" VARCHAR2(38) NOT NULL ENABLE,
"LASTNAME" VARCHAR2(38) NOT NULL ENABLE,
"GENDER" VARCHAR2(30) NOT NULL ENABLE,
"NATIONALITY" VARCHAR2(38) NOT NULL ENABLE,
"GRADE_PASSED" NUMBER(38,0) NOT NULL ENABLE,
"DOB" DATE NOT NULL ENABLE,
"ORPHAN" CHAR(4) NOT NULL ENABLE,
"PARENTAL_INCOME" VARCHAR2(38) NOT NULL ENABLE,
"EMAIL_ADDRESS" VARCHAR2(38) NOT NULL ENABLE,
"POSTAL_ADDRESS" VARCHAR2(38) NOT NULL ENABLE,
"RESIDENTIAL_ADDRESS" VARCHAR2(38) NOT NULL ENABLE,
"YEAR" NUMBER(6,0) NOT NULL ENABLE,
"CELLPHONE_NUMBER" NUMBER(38,0) NOT NULL ENABLE,
"GUARDIAN_NAME" VARCHAR2(38) NOT NULL ENABLE,
"INTERVIEW_NAME" VARCHAR2(38) NOT NULL ENABLE,
"INTERVIEW_DATE" DATE NOT NULL ENABLE,
"SUBJECT_NAME" VARCHAR2(38) NOT NULL ENABLE,
"SUBJECT_MARK" VARCHAR2(38) NOT NULL ENABLE,
"PSYCHOMETRIC_TEST" VARCHAR2(38) NOT NULL ENABLE,
"PSYCHOMETRIC_RESULT" VARCHAR2(38) NOT NULL ENABLE,
"GUARDIAN_CONTACT" NUMBER(38,0) NOT NULL ENABLE,
"STAFF_NAME" VARCHAR2(38) NOT NULL ENABLE,
"STAFF_CONTACT" NUMBER(38,0),
"SPONSOR_ID" NUMBER(10,38),
"SPONSOR_NAME" VARCHAR2(38),
"SPONSOR_ADDRESS" VARCHAR2(38),
"SPONSOR_CONTACT" NUMBER(12,38),
"STUDY_DURATION" VARCHAR2(38),
"GUARDIAN_ID" NUMBER(10,38),
"INTERVIEW_ID" NUMBER(10,38),
"PSYCHOMETRIC_ID" NUMBER(10,38),
"PSYCHOMETRIC_TEST_DATE" DATE,
"REGION_ID" NUMBER(10,38),
"SCHOOL_ID" NUMBER(10,38),
"REGION_NAME" VARCHAR2(38),
"REGION_PLEVEL" NUMBER(10,38),
"SCHOOL_NAME" VARCHAR2(38),
"SCHOOL_LOCATION" VARCHAR2(38),
"SCHOOL_PLEVEL" NUMBER(10,38),
"SEMESTER_ID" NUMBER(10,38),
"SEMESTER_NAME" VARCHAR2(38),
"STAFF_ID" NUMBER(10,38),
"STAFF_TITLE" VARCHAR2(38),
"STUDENT_ID" NUMBER(10,38),
"SUBJECT_ID" NUMBER(10,38),
"STUDY_FIELD_ID" NUMBER(38,0),
 CONSTRAINT "FSAN_PK" PRIMARY KEY ("FSAN_ID") ENABLE
  ) ;ALTER TABLE   "FSAN" ADD CONSTRAINT "GUARDIAN_FK" FOREIGN KEY
("GUARDIAN_ID")
  REFERENCES   "GUARDIAN" ("GUARDIAN_ID") ENABLE;ALTER TABLE   "FSAN"
ADD CONSTRAINT "INTERVIEW_FK" FOREIGN KEY ("INTERVIEW_ID")
```

```
  REFERENCES  "INTERVIEW" ("INTERVIEW_ID") ENABLE;ALTER TABLE  "FSAN"
 ADD CONSTRAINT "PSYCHOMETRIC_FK" FOREIGN KEY ("PSYCHOMETRIC_ID")
  REFERENCES   "PSYCHOMETRIC" ("PSYCHOMETRIC_ID") ENABLE;ALTER TABLE
 "FSAN" ADD CONSTRAINT "REGION_ID" FOREIGN KEY ("REGION_ID")
  REFERENCES   "REGION" ("REGION_ID") ENABLE;ALTER TABLE   "FSAN" ADD
 CONSTRAINT "SCHOOL_FK" FOREIGN KEY ("SCHOOL_ID")
  REFERENCES   "SCHOOL" ("SCHOOL_ID") ENABLE;ALTER TABLE   "FSAN" ADD
 CONSTRAINT "SEMESTER_FK" FOREIGN KEY ("SEMESTER_ID")
  REFERENCES   "SEMESTER" ("SEMESTER_ID") ENABLE;ALTER TABLE   "FSAN"
 ADD CONSTRAINT "SPONSOR_ID" FOREIGN KEY ("SPONSOR_ID")
  REFERENCES  "SPONSOR" ("SPONSOR_ID") ENABLE;ALTER TABLE  "FSAN" ADD
 CONSTRAINT "STAFF_FK" FOREIGN KEY ("STAFF_ID")
  REFERENCES   "STAFF" ("STAFF_ID") ENABLE;ALTER TABLE   "FSAN" ADD
 "STUDENT_FK" FOREIGN KEY ("STUDENT_ID")
  REFERENCES  "STUDENT" ("STUDENT_ID") ENABLE;ALTER TABLE  "FSAN" ADD
 CONSTRAINT "STUDY_FIELD_ID_FK" FOREIGN KEY ("STUDY_FIELD_ID")
  REFERENCES    "STUDY_FIELD"  ("STUDY_FIELD_ID")  ENABLE;ALTER  TABLE
 "FSAN" ADD CONSTRAINT "SUBJECT_FK" FOREIGN KEY ("SUBJECT_ID")
```

REFERENCES "SUBJECT" ("SUBJECT_ID") ENABLE;

```
CREATE TABLE  "SUBJECT"
   (    "SUBJECT_ID" NUMBER(38,0) NOT NULL ENABLE,
 "SUBJECT_NAME" VARCHAR2(38),
 "SUBJECT_MARK" NUMBER(38,0),
  CONSTRAINT "SUBJECT_PK" PRIMARY KEY ("SUBJECT_ID") ENABLE
   ) ;

CREATE OR REPLACE TRIGGER  "BI_SUBJECT"
  before insert on "SUBJECT"
  for each row
begin
  if :NEW."SUBJECT_ID" is null then
    select "SUBJECT_SEQ".nextval into :NEW."SUBJECT_ID" from dual;
  end if;
end;

/
ALTER TRIGGER  "BI_SUBJECT" ENABLE;



CREATE TABLE  "INTERVIEW"
   (    "INTERVIEW_ID" NUMBER(38,0) NOT NULL ENABLE,
 "INTERVIEW_NAME" VARCHAR2(38),
 "INTERVIEW_DATE" DATE,
  CONSTRAINT "INTERVIEW_PK" PRIMARY KEY ("INTERVIEW_ID") ENABLE
   ) ;

CREATE OR REPLACE TRIGGER  "BI_INTERVIEW"
  before insert on "INTERVIEW"
  for each row
begin
  if :NEW."INTERVIEW_ID" is null then
    select "INTERVIEW_SEQ".nextval into :NEW."INTERVIEW_ID" from dual;
  end if;
```

```
end;

/
ALTER TRIGGER  "BI_INTERVIEW" ENABLE;



CREATE TABLE  "PEOPLE"
   (    "ID" NUMBER NOT NULL ENABLE,
 "NAME" VARCHAR2(50) NOT NULL ENABLE,
 "PHOTO" BLOB,
 "FILENAME" VARCHAR2(400),
 "MIMETYPE" VARCHAR2(255),
 "IMAGE_LAST_UPDATE" DATE,
  CONSTRAINT "PEOPLE_PK" PRIMARY KEY ("ID") ENABLE
   ) ;

CREATE OR REPLACE TRIGGER  "PEOPLE_BIR"
   BEFORE INSERT ON people FOR EACH ROW
DECLARE
   peop_id number;
BEGIN
   SELECT demo_prod_seq.nextval
      INTO peop_id
      FROM dual;
      :new.ID := peop_id;
END;
/
ALTER TRIGGER  "PEOPLE_BIR" ENABLE;



CREATE TABLE  "PSYCHOMETRIC"
   (    "PSYCHOMETRIC_ID" NUMBER(38,0) NOT NULL ENABLE,
 "PSYCHOMETRIC_TEST" VARCHAR2(38),
 "PSYCHOMETRIC_RESULT" VARCHAR2(38),
 "PSYCHOMETRIC_TEST_DATE" DATE,
  CONSTRAINT "PSYCHOMETRIC_PK" PRIMARY KEY ("PSYCHOMETRIC_ID") ENABLE
   ) ;

CREATE OR REPLACE TRIGGER  "BI_PSYCHOMETRIC"
  before insert on "PSYCHOMETRIC"
  for each row
begin
  if :NEW."PSYCHOMETRIC_ID" is null then
    select "PSYCHOMETRIC_SEQ".nextval into :NEW."PSYCHOMETRIC_ID" from
 dual;
  end if;
end;

/
ALTER TRIGGER  "BI_PSYCHOMETRIC" ENABLE;
```

```
CREATE TABLE  "REGION"
   (    "REGION_ID" NUMBER(38,0) NOT NULL ENABLE,
 "REGION_NAME" VARCHAR2(38),
 "REGION_PLEVEL" NUMBER(38,0),
  CONSTRAINT "REGION_PK" PRIMARY KEY ("REGION_ID") ENABLE
   ) ;

CREATE OR REPLACE TRIGGER  "BI_REGION"
  before insert on "REGION"
  for each row
begin
  if :NEW."REGION_ID" is null then
    select "REGION_SEQ".nextval into :NEW."REGION_ID" from dual;
  end if;
end;

/
ALTER TRIGGER  "BI_REGION" ENABLE;
```

```
CREATE TABLE  "SCHOOL"
   (    "SCHOOL_ID" NUMBER(38,0) NOT NULL ENABLE,
 "SCHOOL_NAME" VARCHAR2(38),
 "SCHOOL_LOCATION" VARCHAR2(38),
 "SCHOOL_PLEVEL" NUMBER(38,0),
  CONSTRAINT "SCHOOL_PK" PRIMARY KEY ("SCHOOL_ID") ENABLE
   ) ;

CREATE OR REPLACE TRIGGER  "BI_SCHOOL"
  before insert on "SCHOOL"
  for each row
begin
  if :NEW."SCHOOL_ID" is null then
    select "SCHOOL_SEQ".nextval into :NEW."SCHOOL_ID" from dual;
  end if;
end;

/
ALTER TRIGGER  "BI_SCHOOL" ENABLE;
```

```
CREATE TABLE  "SEMESTER"
   (    "SEMESTER_ID" NUMBER(38,0) NOT NULL ENABLE,
 "SEMESTER_NAME" VARCHAR2(38),
  CONSTRAINT "SEMESTER_PK" PRIMARY KEY ("SEMESTER_ID") ENABLE
   ) ;

CREATE OR REPLACE TRIGGER  "BI_SEMESTER"
  before insert on "SEMESTER"
```

```
  for each row
begin
  if :NEW."SEMESTER_ID" is null then
    select "SEMESTER_SEQ".nextval into :NEW."SEMESTER_ID" from dual;
  end if;
end;

/
ALTER TRIGGER  "BI_SEMESTER" ENABLE;



CREATE TABLE  "SPONSOR"
   (    "SPONSOR_ID" NUMBER(38,0) NOT NULL ENABLE,
 "SPONSOR_NAME" VARCHAR2(38),
 "SPONSOR_ADDRESS" VARCHAR2(38),
 "SPONSOR_CONTACT" VARCHAR2(38),
  CONSTRAINT "SPONSOR_PK" PRIMARY KEY ("SPONSOR_ID") ENABLE
   ) ;

CREATE OR REPLACE TRIGGER  "BI_SPONSOR"
  before insert on "SPONSOR"
  for each row
begin
  if :NEW."SPONSOR_ID" is null then
    select "SPONSOR_SEQ".nextval into :NEW."SPONSOR_ID" from dual;
  end if;
end;

/
ALTER TRIGGER  "BI_SPONSOR" ENABLE;



CREATE TABLE  "STAFF"
   (    "STAFF_ID" NUMBER(38,0) NOT NULL ENABLE,
 "STAFF_NAME" VARCHAR2(38),
 "STAFF_CONTACT" NUMBER(38,0),
 "STAFF_TITLE" VARCHAR2(38),
  CONSTRAINT "STAFF_PK" PRIMARY KEY ("STAFF_ID") ENABLE
   ) ;

CREATE OR REPLACE TRIGGER  "BI_STAFF"
  before insert on "STAFF"
  for each row
begin
  if :NEW."STAFF_ID" is null then
    select "STAFF_SEQ".nextval into :NEW."STAFF_ID" from dual;
  end if;
end;

/
ALTER TRIGGER  "BI_STAFF" ENABLE;



CREATE TABLE  "STUDENT"
```

```
   (    "STUDENT_ID" NUMBER(38,0) NOT NULL ENABLE,
 "FIRSTNAME" VARCHAR2(38),
 "LASTNAME" VARCHAR2(38),
 "NATIONALITY" VARCHAR2(38),
 "DOB" DATE,
 "ORPHAN" CHAR(4),
 "PARENTAL_INCOME" NUMBER(38,0),
 "EMAIL_ADDRESS" VARCHAR2(38),
 "POSTAL_ADDRESS" VARCHAR2(38),
 "RESIDENTIAL_ADDRESS" VARCHAR2(38),
 "CELLPHONE_NUMBER" NUMBER(38,0),
 "YEAR" NUMBER(38,0),
 "GENDER" VARCHAR2(38),
  CONSTRAINT "STUDENT_PK" PRIMARY KEY ("STUDENT_ID") ENABLE
   ) ;

CREATE OR REPLACE TRIGGER  "BI_STUDENT"
  before insert on "STUDENT"
  for each row
begin
  if :NEW."STUDENT_ID" is null then
    select "STUDENT_SEQ".nextval into :NEW."STUDENT_ID" from dual;
  end if;
end;

/
ALTER TRIGGER  "BI_STUDENT" ENABLE;



CREATE TABLE  "STUDY_FIELD"
   (    "STUDY_FIELD_ID" NUMBER(38,0),
 "STUDY_FIELD_NAME" VARCHAR2(38),
 "STUDY_DURATION" VARCHAR2(38),
  CONSTRAINT "STUDY_FIELD_PK" PRIMARY KEY ("STUDY_FIELD_ID") ENABLE
   ) ;

CREATE OR REPLACE TRIGGER  "BI_STUDY_FIELD"
  before insert on "STUDY_FIELD"
  for each row
begin
  if :NEW."STUDY_FIELD_ID" is null then
    select  "STUDY_FIELD_SEQ".nextval  into  :NEW."STUDY_FIELD_ID"  from
 dual;
  end if;
end;

/
ALTER TRIGGER  "BI_STUDY_FIELD" ENABLE;




CREATE TABLE  "SUBJECT"
   (    "SUBJECT_ID" NUMBER(38,0) NOT NULL ENABLE,
```

```
 "SUBJECT_NAME" VARCHAR2(38),
 "SUBJECT_MARK" NUMBER(38,0),
  CONSTRAINT "SUBJECT_PK" PRIMARY KEY ("SUBJECT_ID") ENABLE
   ) ;

CREATE OR REPLACE TRIGGER  "BI_SUBJECT"
  before insert on "SUBJECT"
  for each row
begin
  if :NEW."SUBJECT_ID" is null then
    select "SUBJECT_SEQ".nextval into :NEW."SUBJECT_ID" from dual;
  end if;
end;

/
ALTER TRIGGER  "BI_SUBJECT" ENABLE;
```

APPENDIX I: GLOSSARY

Global System for Mobile Communications (GSM): is defined as Global System for Mobile Communication. GSM network usually called as cellular network as the whole coverage area is divided into different cells and sectors. They further stated that mobile Station (MS) is connected to the Base Transceiver Station (BTS) via air interface. BTS contains Transceiver (TRX), which is responsible for the transmission and reception of several radio frequency (RF) signals. The BTS is then connected to the base station controller (BSC) via abis interface (Sharma and Bansal, 2014).

Internetworking: connecting several computer networks together to form a single higher-level network, as occurs in the Internet. There are two basic approaches: encapsulation and translation. The junctions between networks are called gateways, and their functions depend on which internetworking approach is taken (Oxford Dictionary of Computing, 2004).

Node: a point in a computer network where communication lines, such as telephone lines, electric cables, or optical fibres, are interconnected (Oxford Dictionary of Computing, 2008).

Open Systems Interconnect (OSI) reference model: A concept whereby communications-oriented computer equipment with different protocols can be interconnected by means of a data network. The term open systems

interconnection is specifically related to the efforts of the ISO on the seven (7) layer reference model: Physical, Data link, Network, Transport, Session, Presentation and Application layer (Oxford Dictionary of Computing, 2008).

Teleconferencing: a computer-based system enabling users to participate in an activity, such as the management of a complex project, despite being separated in space and/ or time (Oxford Dictionary of Computing, 2008).

Videoconference: a system in which two or more sites, each equipped with a video camera and TV screen, are interconnected by a network so that participants at each site can both see and hear their opposite numbers at the other sites (Oxford Dictionary of Computing, 2008).

West Africa Cable System **(WACS):** is a five point twelve (5.12) Terabit per second (Tb/s) capacity, four pair fibre submarine communications cable with a length of fourteen thousand five hundred and thirty (14530) kilometres linking Namibia with the United Kingdom along the west coast of Africa that was constructed by Alcatel-Lucent (Telecom, 2012).