Broadband as a Public Good

The Pros and Cons

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***Abstract*— from its inception in the 90's broadband has continued to capture and influence economic and social variables globally at astronomic rate. In making a case for public policy on broadband, many studies have sought to identify and measure broadband economic benefits. The everyday benefits of broadband include the medical fraternity remote and complex surgical operations carried out by robots via satellites, executives are empowered to make decisions and access new opportunities through online information and the list is endless. In an increasingly integrated global economy, broadband is central in providing economic growth and competitiveness to any organization, country or region. Few studies however have focused on the complexities and inherent repercussions associated with the deployment of broadband. Much few scholars have zoomed in at broadband as a socially constructed artefact, exuding its relationship and sharing space with societal norms and values. This paper displays the tenets of broadband as a public good, highlighting its value, complexities, demystifying its benefits and applications, attributes, and activities it enables. Finally, the data gathered from thirteen nations of the Sub-Saharan Africa, the Southern African Development Community (SADC) was analyzed in relation to inherent repercussion associated with broadband deployment and its social construction. Some policy suggestions to curb the challenges that come with broadband access are deduced from data including those for the socio-technical relationships.**

Keywords-broadband; public good; deployment; complexities.

I. INTRODUCTION

The context and scope of this research is SADC, which comprise thirteen countries at the time of the research. Therefore, primary data was gathered from these countries. According to [18], mobile penetration in Africa by 2013 was at 63%, leaving broadband as a private good for the select few. There are number of factors that affect broadband penetration and part of them are the inherent attributes and repercussions of cyber space itself [19]. Education, both generically and in matters concerning cyber space is among the main causes of low broadband uptake [2]. Hence, the focus of this paper is to explain the ramifications, intricacies and value of broadband. The question of what determines the other between society and technology in the context of broadband was explored. This aspect was necessary to address the possibility of conflict between cultural beliefs and technology, which could pose a factor of broadband penetration. The primary research question of this paper is how to provide broadband as a public good? The secondary questions are; what are the values, complexities and ramifications of broadband, how can they be ameliorated and how does broadband relate with society?

In section II the sample size, data gathering methods, scope of research and the tools that were used to analyze data are discussed. In section III, the concept of broadband was introduced. Its values, complexities, benefits, application and attributes are differentiated. In section IV, the repercussions of a socio-technical environment are highlighted and the results with regard to these repercussions are discussed. Policy interventions as a means to mitigate the repercussions discussed in section IV are discussed in sections IV (A) and the results concerning these interventions are tabled in the same section. Section V looks at the relationship that ought to exist between society and technology in light of what the participants suggested. Finally, section VI gives conclusions and recommendations for future work.

II. SAMPLE SIZE AND DATA GATHERING

This research used a survey questionnaire and interviews to gather data. The survey questionnaire used consisted of two sections. The first section comprised close-ended questions designed according to [1] reliability standards that enables it to elicit consistent responses. The second section was open-ended question allowing for more insights that are detailed. University students from thirteen SADC countries were used to answer the questionnaires and seven experts were interviewed for completeness of in-depth knowledge on the subject. More than 550 participants responded to the survey questionnaires. This data was collected in 2017. Figure 1 below shows the distribution of participants by country.

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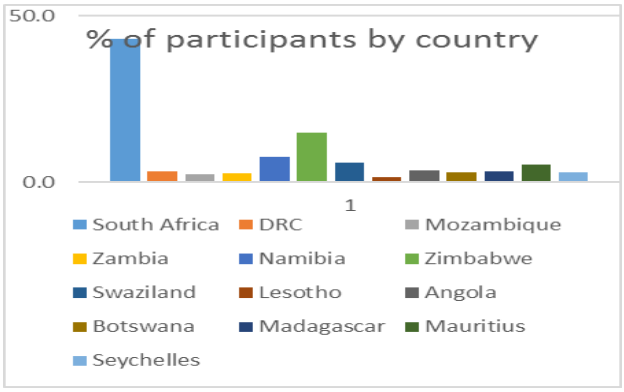

Fig 1. Participation by country

Analysis of the qualitative part from Atlas.ti is not shown in this paper. However, the results shown in Table 1 and Table 2 incorporate those from Atlas.ti. This paper is part of a bigger research that used mixed method approach. The quantitative part of the survey was analyzed using Analysis of a Moment Structures (AMOS) in Software Package for the Social Sciences (SPSS) and that part is not covered in this paper. Only a part of this big research is presented in this paper.

The following section defines broadband and introduces it as a public good.

III. BROADBAND

This research uses as a working definition of broadband as "the provision of telecommunications infrastructure that enables information traffic in a continuous and uninterrupted manner, with sufficient capacity to provide access to data, voice and video applications that are common or locially relevant to users as determined by the" SADC "from time to time" [2].

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

A. *Broadband as a public good*

In some developed and developing nations, the government runs broadband or state controlled agencies until late 20th century [3]. In congruent with these two, the move to have telecommunication controlled by the state was necessitated among other things by the need to protect those aspects of telecommunications that are of public interest. Today, even though many telecommunications markets have been privatized and liberalized, government regulatory agencies are still responsible for ensuring that public good issues are provided for. These issues are security, prevention of interference while transmitting and client safety. Two things distinguish public goods from all others and these things are: Non-excludability, which means any member consuming a public good cannot be denied it by another member enjoying the same public good [3]. The second characteristic is that a public good is non-rivalry in consumption [3]. This means therefore that the government to guarantee non-rivalry in the market should provide for public goods. In some developed countries, broadband forms part of Universal Service Obligation (USO), meaning that it is the citizens' right, to have access to it and governments should provide for it. In most countries, however telecommunications is just a universal service and not necessarily an obligation on the part of government. It is in the potential benefits of broadband and a common thrust to bridge the digital divide which gives broadband its public good character.

B. *Value and complexities of broadband*

According to [4], broadband is a tool for the development of economies that are based on knowledge. Many studies corroborate that enhanced broadband penetration has desirable effects on the growth of any economy, improved access and delivery of social services apart from bridging the digital divide. All these impacts of broadband result in high quality way of living and economic index of countries. According to [5], broadband is at the center of organizations' improved efficiency, faster connectivity, and access to operation-specific applications which usher in new ways of doing business and give birth to new business models.

In considering the value of broadband, research has concentrated on benefits of it singly without taking into account the problems that inherently comes with these benefits. There are quite some complex issues that tend to hinder proper of the benefits of broadband. One such issue is the confusion that literature has had between benefits of broadband and its applications, attributes of broadband and the activities that these attributes enable. "Applications include video on demand, gaming, streamed video, and voice over the internet. Attributes include greater speed, always on and the capacity for Local Area Networks (LANs). The activities that these attributes enable include teleworking, e-gaming, e-gambling, e-learning, e-health, e-commerce, and e-government" [6]. Publications of repute and which have contributed immensely to broadband research but which made this ontological error include International Telecommunications Union (ITU) on their briefing paper on broadband promotion according to [7].

The other one is that confusing benefits with activities gives the notion that it is gross outcome rather net that counts. In so much as broadband-enabled activities bring benefits, they also have negative outcomes which include increased worker isolation and less mentoring in the case of teleworking, financial problems (e-gambling), and displacement of conventional social contacts in general [8].

Another complexity is that of cost, if the cost of broadband excludes multiple voices in favor of a monopoly then there is need for constitutional and social considerations [5]. From the above given arguments, it is clear that a high broadband penetration does not equally mean high broadband benefits. Furthermore according to [9],

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calculated revenues expected to be coming from broadband related enterprises do not reflect an adequate measure of benefits of broadband. Lastly, owing to poor planning and veiled understanding of broadband scenarios, the ways by which governments sometimes attempt to use to grow broadband may disrupt the economic and social dynamics [10].

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

1) Edducation: According to [5], where e-learning is asynchronous, meaning where there is no need for real time interaction between student and instructor, narrowband is sufficient. However when synchronous and collaborative learning in real time takes place, broadband is needed. Where multiple students access the web simultaneously, even for asynchronous e-learning, broadband is needed. Broadband therefore has the ability to provide educational platform which transcends geographical and financial challenges [4]

2) Health: Broadband applications that are health specific and services are significantly improving health and medical outcomes around the world, particularly for patients in remote areas and those with limited mobility, through e-health and m-health initiatives [11]. In view of the fact that in 2012 there were "fewer than 27 million doctors and nurses for the more than 6 billion people in the world and only 1.2 million doctors and nurses in the lowest-income countries", using mobile technologies is a valuable tool for enabling health care practitioners to reach patients [12]. In spite of the fact that voice and data connections can be useful in improving medical care, broadband connectivity is necessary if full potential of e-health services that include telemedicine, which enables real-time audio and video communications between patients and doctors as well as between health care providers, broadband connection is required. Online medical procedures need high processing power, huge storage capacity, much bandwidth and protection of personal data of patients [13]..

3) E-Governance: E-government refers to a wide range of applications that transform government processes and the ways in which governments connect and interact with businesses and citizens. This facilitates citizens participation in national issues and society, improves accountability, effectiveness and efficiency in governments' day today business. Broadband is an essential component of e-government, since it provides the foundation for public administration networks that allow smooth flow of processes. E-government can in return be a catalyst for increased demand for broadband as basic services are made available online, consultations with citizens on issues of policy and online multimedia as two way exchange technology. Tax returns, debate forums, applications and registrations are all made easily available by e-government as enabled by broadband. Republic of Korea, the United States, and Canada are in the top three places with regard to the number of online government services available. However, countries have made significant progress over the last two years, including Bahrain, Chile, Colombia, and Singapore. In addition, the use of mobile phones for e-government services, such as alert messages, applications, and fee payments, is almost as popular in developing countries as it is in developed countries [14].

4) Gross Domestic Product: A study by the World Bank cited by many researchers found out that for low to middle income countries "about a 1.38 percentage point increase in GDP for each 10 percent increase in broadband penetration" between the years 2000 and 2006 [15]. The same study further revealed that broadband impact was more in developing economies than in developed countries which "enjoyed a 1.21 percentage point increase in per capita Gross Domestic Product (GDP) growth" for each 10 percent increase in broadband penetration. This study also evidenced that broadband has a potentially larger growth effect than other Information Communication Technologie (ICTs), including wireline telephony, mobile telephony, and the Internet. There are other studies that confirm the findings of the World Bank such as Management consulting firm McKinsey and Company which estimated that "a 10 percent increase in broadband household penetration delivers a boost to a country's GDP that ranges from 0.1 percent to 1.4 percent" [16]. It therefore, follows that broadband can increase the economy of a country by e-commerce, creating new jobs, developing and attracting new industries and by providing access to local, regional and global markets.

5) Cloud Computing: Cloud computing generally allows storage, processing and instant access to applications and data remotely via broadband connectivity [17]. This translates into reduced costs of IT infrastructure including hardware, software and technical support. The point to note here is that the benefits of cloud computing are directly the benefits of broadband because without broadband cloud computing as we know it today would not be possible. According to [17], cloud computing has the following other potential benefits: reduced need for up-front investment, since cloud computing is typically based on a pay-as-you-go pricing model, lower operating costs, since the service provider does not need the provision capacities according to the peak load, easy access through a variety of broadband-enabled devices and lower business risks and maintenance expenses, since business risks (such as hardware failures) and maintenance costs are shifted to infrastructure providers, which often have better expertise and are better equipped to manage these risks. There are many other benefits of broadband such as leisure, entertainment, social

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relations, gaming, green computing, aviation and much more. Governments across the globe have set out ambitious targets for broadband growth and penetration due to the unquestionable value of broadband as discussed above. Notwithstanding the benefits of broadband, these come with some side effects. The following section discusses the challenges associated with broadband growth and penetration.

IV. THE RAMIFICATIONS OF BROADBAND

A question was posed to participants to the effect of identifying the repercussions that are caused by broadband penetration. The chart below gives the most significant phrases in answering this question:
Digitization and computerization of services has social repercussion among workers and customers. Which are some of these repercussions in your opinion? The responses to this question are illustrated in Figure 2. In the figure, the size of the shapes indicates the percentage of participants that gave similar answers. This question's responses were integrated with responses from experts to reach a more robust conclusion in answering the objective of social repercussions. Figure 2 was further refined and integrated with expert responses resulting in the following Table 1.

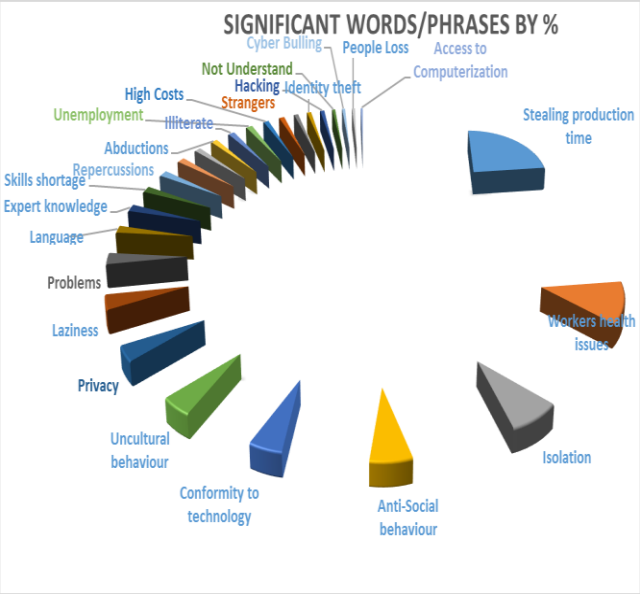

Fig 2. Cyber space ramifications

TABLE I. BROADBAND REPERCUSSIONS

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

A. *Policy intervations*

The following quotations are extracted from the primary documents of responses given by some experts to various interview questions. In response to the question of negative social effects of broadband and the possible solution to that, the expert said the following:

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

In this response, the expert called for a balance between the implementation of broadband and an equally important implementation of the educational programs on correct and incorrect use of it. Here, the experts indicate that the gains intended to be achieved by such technological developments can be reversed by lack of education about the same development. Education has been the preeminent solution to many attributes. Targeted education to address the ills of misuse of broadband is needed from the expert's point of view. Table 2 below summarizes some of the policy solutions given by experts with regarding the broadband ramifications. Given below is just a subset of all the responses.

TABLE II. POLICY INTERVENTIONS

Social Repercussions			
Data integrity	Anti-social behavior	Unproductivity	Identity theft
Policies for social repercussions			
Encryption	Education	Targets	Secure networks
White hat hackers	Mentorship	Incentives	Best practices
	Team work	Performance management	

The interventions highlighted by the experts manifest themselves in various ways but their themes remain the same. These results are useful to decision makers at different levels of management in curbing the negative effect of cyber space. The following section deals with question of the relationship that should exist between technology such as broadband and the society in which it is used.

V. SOCIETY AND TECHNOLOGY

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

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

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

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

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

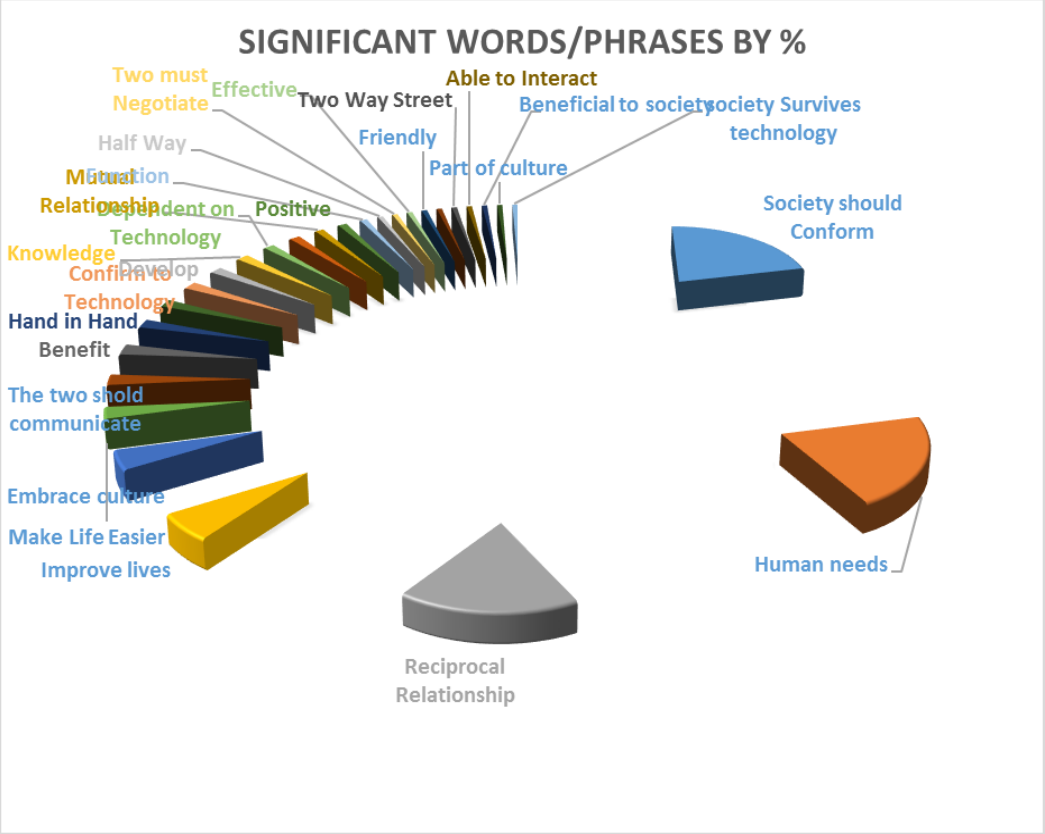

Fig 3. Socio-technical relationship

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

"Technology should not be a garget but a solution to a problem. That is the solution. Therefore, any piece of technology that does not answer to problems of society at

hand then it's not useful. Therefore society should come first in every case. Technology should come to fill a gap but at the end, the solution should benefit society. Eg etolls in SA, it's a good
Technology but it's not filling the gap. Society does not need it. There should be another model."

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

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

Figure 2 attempts to summarize the responses on this question On technology-society relationship, the result reveals that the majority of respondents are of the opinion that society should take credence over technology. The researcher therefore has reason to accept that in SADC society takes precedence over technology

VI. CONCLUSIONS AND RECOMMENDATIONS

In conclusion, it has been evidenced that a socio-technical environment like broadband has inherent, negative unintended ramifications that come with it. Such ramifications can be provided for by enacting policies aimed at reducing their effects. These two variables have been explored within the context of SADC where broadband is provided for as a public good. Lastly, the relationship between technology and society has been interrogated and as much as some participants suggest one of reciprocal shaping, most of them concur that society should take preeminence over technology. It is recommended that further research can done on each of the aspects of the research questions separately and concrete results for each be discussed separately. A times series research of the same phenomenon is also recommended to establish if the socio-technical environment of broadband changes significantly with time.

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