INFORMATION AGE AT CROSSROADS: A CASE OF BROADBAND FRAMEWORK IN SADC

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Abstract - On a world scale, SADC countries rank among some of those with the lowest broadband growth and penetration (BGP), making it one of the least competitive regions globally. This phenomenon has its roots in the frameworks being used to promote broadband adoption among other things in these member states. This paper sought to explore challenges inherent within the rapid technological evolution in light of societal values, cultures and uniqueness.A socio-technical systems theory was used as the lens to expose the factors, attributes and repercussion of a socio-technical environment

Index terms - Socio-technical systems theory, broadband.

I. INTRODUCTION

The transformative benefits of broadband on economic and social variables have led governments to set ambitious targets for its deployment. In making a case for public policy on broadband, many studies have sought to identify and measure broadband economic benefits. Little to no success has been registered in improving the uptake of broadband especially in developing economies. The definition of broadband evolves with time and depends on the socio-economic formation of the people defining it. So different nations have different definitions of broadband which they keep revising from time to time (Gorejena 2016). Therefore there is no one definition for broadband. As cited by Gorejena (2016), definitions of broad band based on data transfer speed do not consider the fast pace at which technology is evolving. This research uses as a working definition of broadband as "the provision of telecommunications infrastructure that enables information traffic in a continuous and uninterrupted manner, with sufficient capacity to provide access to data, voice and video applications that are common or socially relevant to users as determined by the" SADC "from time to time" (World Bank 2014). In this research broadband growth refers to the geographical reach of broadband infrastructure while broadband penetration speaks to the number of people that are actually connected and using broadband.

II. MOTIVATION FOR THIS RESEARCH

Facts and figures about broadband growth and penetration in Africa SADC however show that a lot remains to be done when compared at the world stage. The following illustrations speak to the reality in sub-Saharan Africa. Fig 1 shows cellular mobile subscription penetration and subscription growth rate between 2005 and 2013. Only about 63% of African population had mobile connectivity by 2013 connected. The analysis of these graphs is given in the following section.Comparing these numbers with the world population of about 7.1 billion, would reveal that SADC and transitively Africa has significantly a small number of mobile subscribers on world stage.The first graph of Fig 1 indicates that Africa is the least in terms of mobile cellular penetration and this translates directly into SADC's poor penetration globally. The second graph of Fig 1 shows that even though there has been an increase in mobile subscriptions over time the rate of growth has decreased, even more rapidly in developing nations like in Africa. Both the developed and the developing nations are fast reaching saturation of their markets but for entirely different reasons.

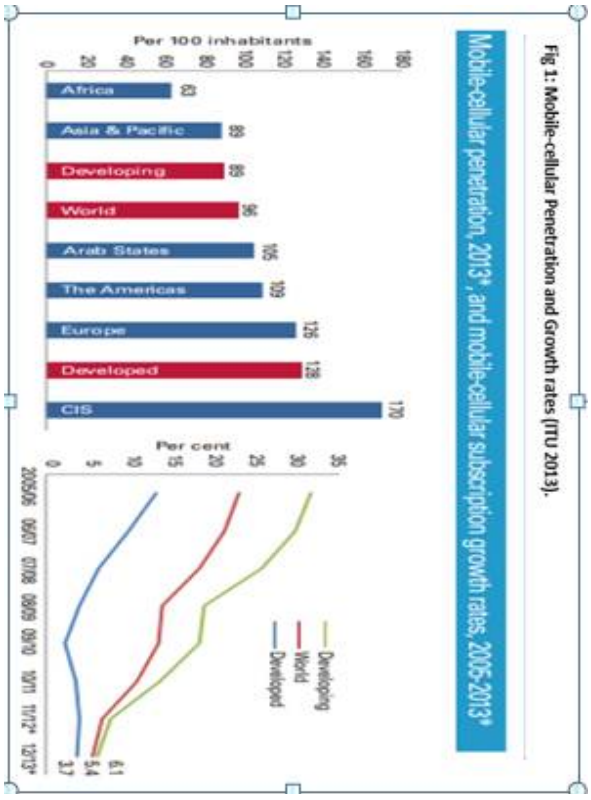
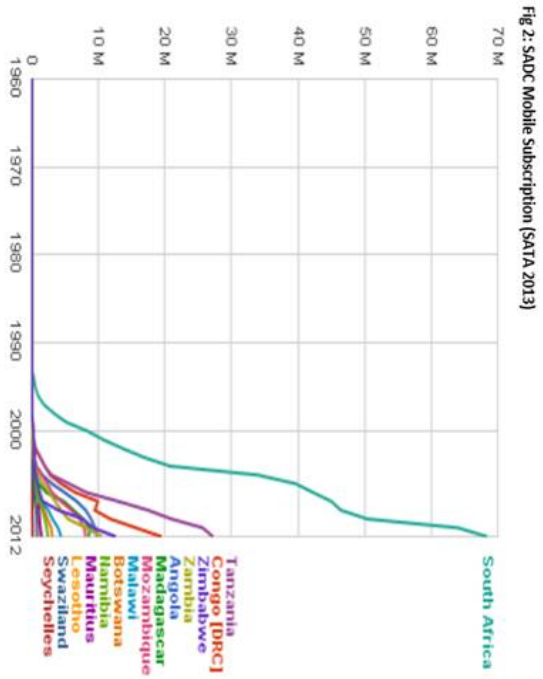


Fig 1: Mobile-cellular Penetration and Growth rates (ITU 2013).

The constant value of mobile subscription approached by developing economies does not immanent from the same cause as that for the developed world. In the developed world, this is due to market saturation whereas in Africa and it is mostly due to high pricing which leads to a small catchment market and this market fast got saturated (Esselaar & Gillwald 2007). This research suggests that apart from monopoly and pricing of broadband, there are other latent factors of intricate relationships that affect broadband uptake in Africa particularly. For easy comparison with the rest of Africa and the entire world, Fig 2 shows SADC's mobile subscription.



III. THEORETICAL FRAMEWORK

This section explains the theoretical underpinnings of this paper and they comprise the standard theory used to coach the research, reviewed literature and the design that was followed by the research.

3.1. Socio-Technical Approach to Broadband.

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

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

IV. METHODOLOGY

Research methodology is based upon a philosophy, philosophical stances form a continuum. There are, four main positions are largely agreed upon and these are positivistic, interpretive, transformative and pragmatic methodologies (Creswell 2014). This research used pragmatism which formed the basis for the mixed methods approach adopted

4.1. Purpose of mixed methods

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

Complementarity

This when mixed methods are used in order to gain complementary views about the same phenomena or relationships (Soffer & Hader 2007). An example would be when a qualitative study is used to gain additional insights on the findings from a quantitative study.

Completeness

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

V. RESULTS AND INTERPRETATION

5.1. Analysis of the best fit model

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

As can be observed in Fig 3, none of the factor loadings are below 0.4. This validates all the BGP factors as suggested by literature. From the tables of indices of the best fit model only the indices of

interest were extracted and presented in Table 2 below.

Chi-square	RMSEA	CFI	GFI
330.026	.054	.937	.935

Table 2: Fit Indices

The chi-square value has reduced significantly through the four modifications done. This last value of chi-square owes its size to a large sample used and is vindicated by other indices. CFI value of one denotes the best fit. The cut-off point is 0.9. In this model the CFI obtained is well within acceptable range. For an acceptable fit the values of RMSEA should be below 0.6. The smaller the error the better the model is. This condition is satisfied in this model. The cut-off point for GFI is 0.9 with 1 being the best fit.

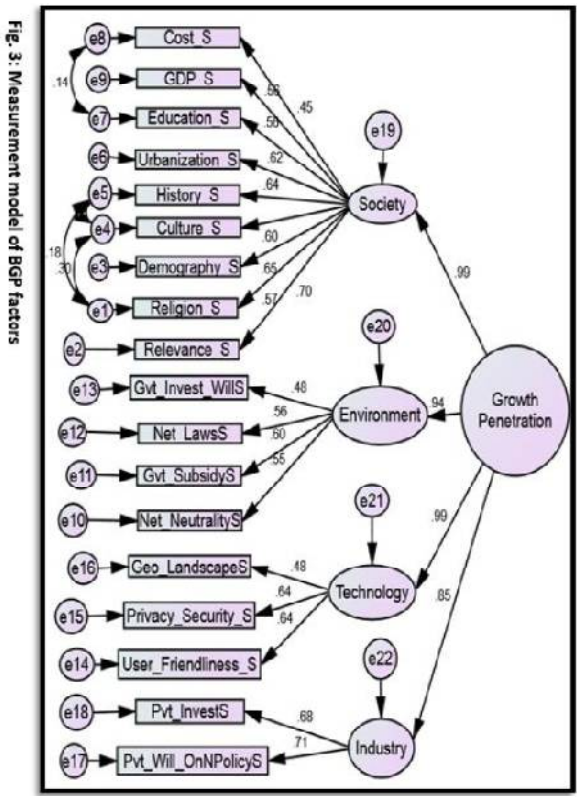


Fig. 3: Measurement model of BGP factors

Table 3: Construct validity of CFA measurement model

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

Measurement validity is shown in Table 3 below giving the CR and AVE of the variables in the measurement model. According to Fornell and Larcker (1981) all the indices of CR are acceptable because they are above 0.6 cut-off point for CR. However, the first three of the AVE are below the cut-off point of 0.5 for AVE. This discrepancy could be emanating from the fact that the first order latent variables are highly correlated and yet the researcher could not collapse them into common variable because they are informed by the standard theory (STST) that was used in this research. Given that the factors that affect broadband growth and penetration in SADC have been identified and confirmed quantitatively, the next step in the analysis is to identify the interventions needed to address these factors

5.2. Interventions and their ratios

The purpose of this analysis is to highlight policy as the solution to the question of broadband growth and penetration in SADC. Using policy as a tool to address both business and social challenges is widely accepted in literature and validated by participants as no other type of intervention was suggested. In answering the question of which policies would be suitable per given broadband growth factor, the responses given are summarized in the Table 4

Factors	3:1	1:3	1:2	2:1	1:1	Other	Count
Political will	81	111	**126**	112	58	6	494
Landscape	45	99	**121**	118	54	13	450
Pvt Inst	40	67	**131**	81	56	6	381
Internet laws	31	70	**108**	102	79	15	405
Gvt subsidy	34	71	**128**	88	69	10	400
Gvt/Pvt partnership	37	82	**123**	99	68	12	421
Net Neutrality	48	101	**76**	87	92	18	422
Other	17	12	**32**	20	26	11	118

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

Factors	3:1	1:3	2:1	1:2	1:1	Other	Count
GDP per capita	86	100	**101**	75	52	9	423
Cost	71	76	**144**	90	63	14	458
Level of education	83	72	**124**	100	59	10	448
Urbanization	57	54	**109**	113	58	15	406
History	47	45	**120**	79	75	12	378
Culture	52	61	**98**	82	81	14	388
Demography	50	60	**120**	92	64	11	397
Privacy and security	37	88	**91**	112	61	14	403

The following BB penetration result were analysed in the same way. Taking the same approach as for BB growth factors it can be noted that from Table 5 below that more social policies are needed to promote

broadband penetration in SADC as the first and third columns add to more preferences than do second and fourth columns. The predominant ratio for these factors is two social policies for every one business policy save for the highlighted factors. It is indeed arguable that the three heighted penetration factors can be addressed by business policies predominantly. However it is also important to note that the difference in numbers for these three factors aremarginal, almost negligible. From the above results the research can conclude that to increase broadband penetration in SADC more social policies are needed at an average ratio of two social policies for every business policy. When both categories of factors are put together and ranked in the order of their influence, the following graph resulted. A total of eighteen factors were ranked but only the first four factors are shown in the graph in Fig 4.Notably, in Fig 4 the first four most influential factors of BGP are penetration factors.

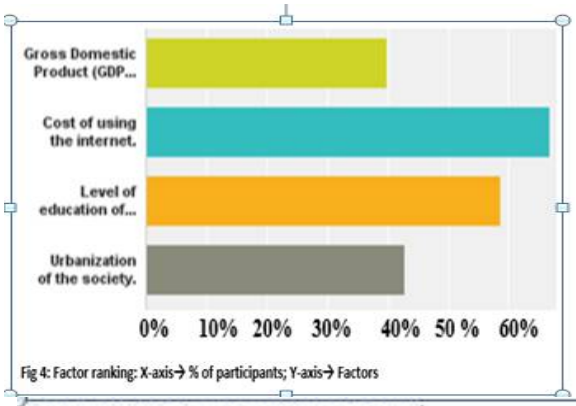


Fig 4: Factor ranking: X-axis→ % of participants; Y-axis→ Factors

Table 6: Decision making tool

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

Table 6 forms the first part of the proposed framework. The y-axis are the factors of broadband growth and penetration which are categorized by STST in accordance with its subsystems. These factors were obtained from literature and confirmed by CFA. The factors are also ranked in order to determine the most predominant ones. On the x-axis are the interventions for each factor in form of social and economic or business policies. These policies are compared by ratio in order to ascertain the most needed kind of policies. If this framework is populated with instances of the above results for SADC then decision makers can easily be guided on how to enact and apply policies.

Table 7 Attributs and policy solutions

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

In addressing attributes and repercussions of the socio-technical environment, six experts were interviewed and more than 450 people answered the qualitative questions online. The interviewed experts are from selected SADC countries. Both of these sets of questions were analysed using Atlas.ti. Further to analysing interview qualitative responses using Atlas.ti, a Survey Monkey Text Analysis tool was used to further analyse the online survey. These policies are not exhaustive. Some of them repeat in various attributes due to their general application. However the details of these common policies would not be the same when applied to their respective attributes. The following table, Table 7 gives some of the attributes and their policy solutions of a socio-technical environment as indicated by SADC participants. The researcher needs to underscore the fact that while the given set of attributes can be

identical according to literature and results of this research but they manifest differently among different nations, hence the need for consultations first.

5.3. Policies that address social repercussions of a socio-technical environment

Most repercussions of a cyberspace have an element of criminality and can almost all be avoided. The proposed framework for broadband growth and penetration in SADC was necessary because solutions in the form of policies may be sought after to address these social ills in our socio-technical environments. So policy propositions that were suggested by participants are discussed in this section. These should help decision makers who may find the proposed framework useful for them. Table 8 presents the social repercussions that were identified by participants as present in a socio-technical environment and the suggested policy interventions that can be used to address each one of the repercussions

Table 8: Social repercuusions and policy solutions

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

5.4. Meta-inferences

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

In line with the above, the following meta-inferences (MI) were drawn from this research:

MI 1

For an accurate determination of factors that influence broadband growth and penetration among a people group, the process of consultation with the stake holders should be conducted first

MI 2

Attributes and social repercussions of a socio-technical environment form a subset of the factors that influence.

MI 3

Common policies can be used to address both attributes & repercussions and factors of BGP

MI 4

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

MI 5

Broadband penetration and social repercussions require more social policies than business and broadband growth and attributes require more business policies than social

CONCLUSIONS

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

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