Towards a Model for Assessing the Sustainability of Rural Community Networks

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ABSTRACT

Half of the world population is now connected onto the Internet, most of whom are urban dwellers. Rural communities rank very low in terms of connectivity. Financial viability has hindered telecommunications providers from extending services to such areas. Governmental and non-governmental agencies have all been making several initiatives to carry rural communities especially in Africa along. One initiative that has proven successful is the Community Network (CN); an Internet infrastructure built and handed over to the community to run sustainably. About half of the CNs created have failed due largely to failed sustainability plan. This work attempts to study the sustainability plan of Tunapanda Community Network in Kenya, Africa, with a view to modelling the sustainability within the spheres of the various factors that contribute to their success.

Keywords: Community Network, Rural Africa, Community Awareness, Dynamic system, System modelling

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1. INTRODUCTION

Defining sustainability is difficult as it varies by scale and context (Vos, 2007). However a widely accepted definition comes from Keeble (1988). He defined sustainability as the development that meets the need of the present generation without compromising the ability of the future from meeting theirs. Contextualizing this to Community Network (CN), infers that CN can be said to be sustainable if the cost of providing the service to the community does not surpass the financial inflow for offsetting the incurred bills. Studying the factors that ensure sustainability in a CN amounts to seeking insight into the dynamics of the interactions between the various components of the network ranging from the devices to the human component. An excellent tool for getting that insight is the application of systems modelling. System modelling according to Puliafito & Trivedi (2019), can be seen as an abstraction of a real system for deriving and analysing its behaviour under different functioning conditions, in terms of performance of the system and its dependability, without the need to refer back to measurements on the real system as a whole or its prototype. Contextually, modelling a sustainable system will involve an abstraction of the system where parameters that can influence the performance of the system are tweaked differently to have an insight of their effect on the overall sustenance of the system.

Community networks are defined as community-based Information and Communication Technology (ICT) organizations created to provide universal access to the Internet and to the use of ICT systems for the promotion of local economy, social development, civic participation and community learning (Longford, 2008) (Gurstein, 1999). This infers that the success of the community network is largely dependent on the sustainability drive of the community. Quite recently there has been a drive to bridge the digital divide in rural Africa using CNs (Rey-Moreno, 2014). It involves setting up the network infrastructure using a seed grant and volunteering man power from the local communities. Ownership and management of the facility is then transferred to the community after the implementation. Issues surrounding sustainability has seen quite a number of these initiatives failing. This paper attempts to create a sustainable model of a CN using parameters from Tunapanda CN; one of the most successful rural community networks in Africa as contained in the report of (Rey-Moreno).

2. RELATED LITERATURES

Community Network (CN) is an information and communication network for the people, by the people (Longford, 2008) serving both the developed world (O'Beirne, 2010) and the developing world (Williams, Falch, & Tadayoni, 2017). Even though there is high need for CNs, they are quite new in Africa with the oldest being Macha Works (van Stam & van Oortmerssen, 2010). Debuting in 2003 in rural community of Macha in Zambia, now there are about 37 CN scattered across Africa (Rey Moreno & Graaf, 2016) with only about half of that number successfully operating (Rey-Moreno, 2014). Reason for this high rate of failure in the African initiatives bothers around sustainability (Rey Moreno & Graaf, 2016). Several attempts have been made at coming up with a sustainability plan for rural CNs in Africa. Williams et al. (2017), in his framework, identified public and private stakeholders that can partner together to ensure successful implementation of CNs in sub Saharan Africa. The research however is centered on provision of the CN infrastructure and dwelled little on its sustainability over time. Earlier on, Hoffman and De Wet (2011) presented a model that simulated the relationship between market, product, technology and financial variables and their impact on the delivery of broadband service to rural Africa.

His emphasis however was on getting a cheaper alternative for implementing the CN and effective accounting of its proceeds. Perhaps discussion on sustainability of telecentres will not be complete without x-raying the excellent work done by Mphahlele and Maepa (2003). This research presented twelve critical factors that affects the sustainability of a telecentre (CN) using information from six telecentres in Limpopo district of South Africa. According to the paper, the telecentres are setup by a government agency as part of the South African drive towards bridging its digital divide. Even though it was successful in South Africa, such initiative from government agency have been known to have high failure rates in lots of countries (Ahmad Nawi, Azizah, & Ibrahim, 2012). More so, (Mphahlele & Maepa) did not present how these factors are interrelated. This paper however, seeks not only to identify the factors affecting CN sustainability, but it goes further to establish how the identified factors interrelate.

3. METHODOLOGY

Most CNs start up by a generous seed grant from non-governmental and governmental agencies that support community network creation. The received seed grant is used to acquire the necessary infrastructure for the building of the CN. To facilitate easy and seamless handover members of the community are encouraged to volunteer their time in the network buildup for them to acquire requisite skills to be able to maintain the equipment as well as man the day-to-day running of the network. To achieve this, massive awareness campaigns are staged in the form of town hall meetings and roadshows.

Additionally the campaigns attempt to get the general community buy-in into the project as its success depends on how much support the project gets from the community. Other factors that can influence the buy-in include culture and belief of the community. After commissioning the community network is expected to sustain itself from its generated revenue. Its ability to achieve sustainability largely depends on what remains of the revenue after the payment of all expenditures (Liabilities) for the month as illustrated in the conceptual model in fig. 1.

The model in fig. 1 was inspired by a virtual meeting held with a representative of TunapandaNET; A successful CN in Kibera, Kenya. In the meeting the success story of TunapandaNET was showcased and how the various factors interrelate to ensure a sustainable CN.

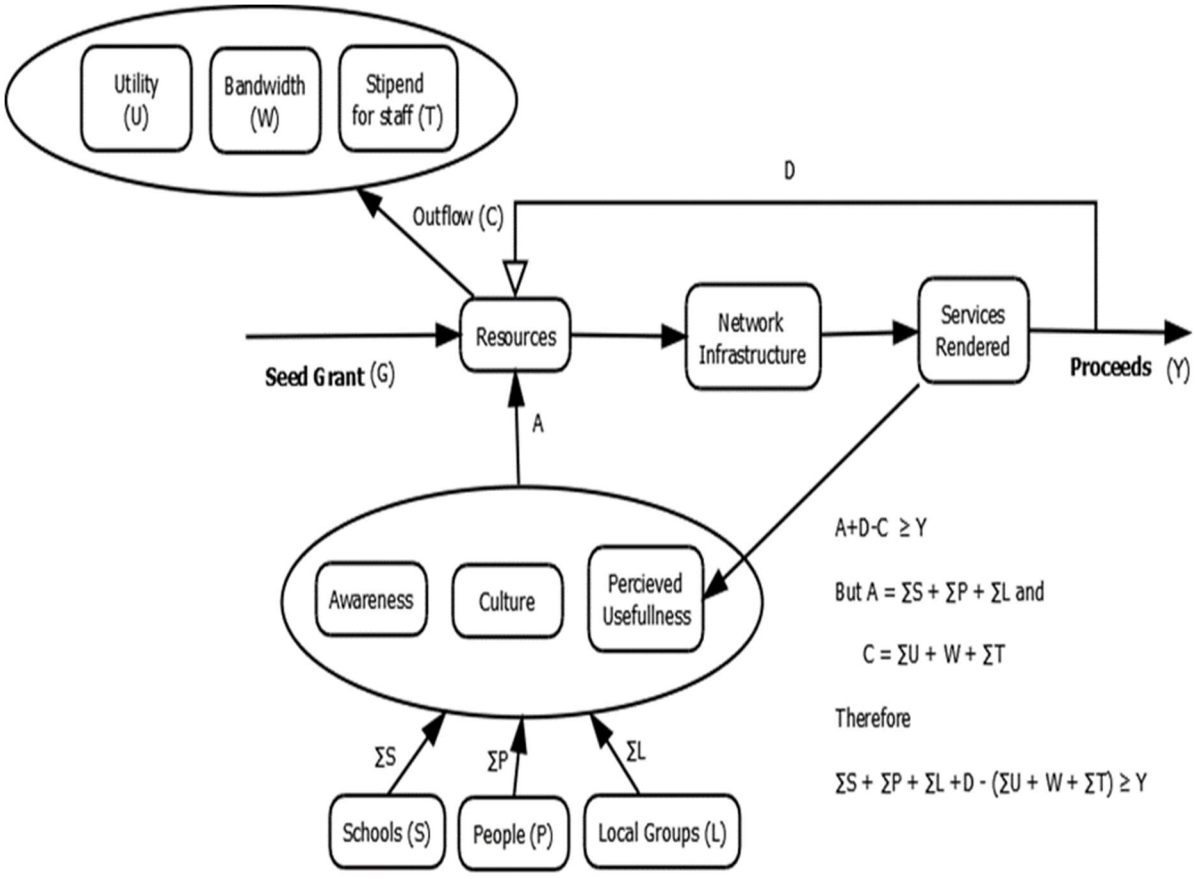

Figure 1: Model of Sustainability for Rural Community Network

The model in fig. 1 is a contextualization of the three dimensions of sustainability; Economy, Environment and Social dimension (Moir & Carter, 2012), where the economy is represented by the financial dynamics that depletes and replenish the sink labelled Resources, the environment dimension is represented by the infrastructure and services rendered and the social dimension is analogous to the social and cultural factors that influence the community buy-in into the system.

The overall relationship can thus be captured in equation I as:

$$A + D - C \geq Y - - - - - \text{(I)}$$

Where A = Summation of all cash in-flows into the system
D = Reinjection of the profit made from rendering services to the community
C = Total cost of al expenditures incurred in making the system work
Y = Total profit from services provisioning from the CN

Cash in-flow A is a subject of subscription payment by the three identified categories of subscribers;

i. Subscription from schools S
ii. Subscription from individuals P
iii. Subscription from local groups L

Assuming uniform cost of subscription for each category of subscriber, then A can be written as in equation II

$$A = \sum S + \sum P + \sum L - - - - - - \text{(II)}$$

Also total cost of expenditure C is the summation of costs of utilities (U) such as electricity and water bill, monthly cost of bandwidth (W) and the monthly wage of the employed workers (T). Thus C can be summarized in equation III as:

$$C = \sum U + \sum T + W - - - - - - \text{(III)}$$

Substituting for A and C in equation I will give equation IV

$$\sum S + \sum P + \sum L + D - (\sum U + \sum T + W) \geq Y - - - - - \text{(IV)}$$

In order to factor in awareness, culture and perceived usefulness into equation IV as illustrated in fig. I, the following assumptions were made.

1. The higher the level of awareness within the community the more individuals and groups subscribe to the CN.
2. The more the CN promote the cultural heritage of the community, the more individuals and groups subscribe to the CN.
3. The more the community perceive the usefulness of the CN in their socio-economic lives, the more buy-in the CN gets from the community.

Each of these assumptions can be quantified using empirical research tool to get their values as percentage with values ranging from 0 to 1. If α= Percentage awareness, β=percentage of cultural influence and Ω=percentage perceived usefulness, the sustainability equation thus becomes:

$$\alpha\beta\Omega(\sum S + \sum P + \sum L) + D - (\sum U + \sum T + W) \geq Y - - - \text{(V)}$$

where $0 \leq \alpha\beta\Omega \leq 1$

Equation V will always hold for sustainability of the network. It can be observed that a balance will need to be maintained between the left hand side (LHS) of the equation and its right hand side (RHS). A cumulative sum of the LHS must produce a threshold value that must be at least equal to the RHS for sustainability to hold. A change in one or more components on the LHS will have to be catered for by at least an equivalent change in other components of the LHS to maintain the threshold value that guarantees sustainability.

4. CONCLUSION AND FUTURE WORK

This sustainability model need to be tested with data from the CN scattered across several countries in Africa to test its efficiency. The components that provide data that influence the behavior of the system need not be exactly the same as the ones captured. All that is needed is to identify where it belongs either in in-flow or out-flow and to be placed appropriately for the test to be carried out.

Again there is a need to explore ways of injecting the contributions of awareness, culture and perceived usefulness to be able to complete the model with all factors accounted for.

REFERENCE

1. Ahmad Nawi, H., Azizah, A., & Ibrahim, O. (2012). Government ICT project failure factors: project stakeholders' views. *Journal of Information Systems Research and Innovation, 2*, 69-77.
2. Gurstein, M. (1999). *Community Informatics: Enabling Communities with Information and Communications Technologies:* : IGI Global.
3. Hoffman, A. J., & De Wet, D. P. (2011). Broadband internet access for rural Africa: finding a viable model.
4. Keeble, B. R. (1988). The Brundtland report:'Our common future'. *Medicine and War, 4*(1), 17-25.
5. Longford, G. (2008). Community networking and civic participation: surveying the Canadian research landscape. *The Journal of Community Informatics, 4*(2).
6. Moir, S., & Carter, K. (2012). *Diagrammatic representations of sustainability–a review and synthesis.* Paper presented at the Procs 28th Annual ARCOM Conference.
7. Mphahlele, M. K., & Maepa, M. E. (2003). Critical success factors in telecentre sustainability: a case study of six telecentres in the Limpopo Province.
8. O'Beirne, R. (2010). *From lending to learning: the development and extension of public libraries*: Elsevier.
9. Puliafito, A., & Trivedi, K. S. (2019). Systems Modelling: Methodologies and Tools *Systems Modeling: Methodologies and Tools* (pp. 1-7): Springer.
10. Rey-Moreno, C. (2014). Understanding CommunityNetworks in Africa. *Report. Internet Society, May*, 20.
11. Rey Moreno, C., & Graaf, M. (2016). Map of the community network initiatives in Africa. *L. Belli, Community connectivity: building the internet from scratch*, 149-169.
12. van Stam, G., & van Oortmerssen, G. (2010). *Macha Works!*
13. Vos, R. O. (2007). Defining sustainability: a conceptual orientation. *Journal of Chemical Technology & Biotechnology: International Research in Process, Environmental & Clean Technology, 82*(4), 334-339.
14. Williams, I., Falch, M., & Tadayoni, R. (2017). A Public Management Framework for wireless broadband development in rural Sub-Saharan Africa. *Marketing i Zarządzanie, 50*, 89-116.