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Social Enterprise Logic and the Sustainability of Community Networks in Sub-Sahara Africa: Lessons from the Zaria Community Network in Nigeria

Auwal Alhassan Tata
Department of Information Systems, School of Information Technology and Computing, American University of Nigeria, Yola, Adamawa State, Nigeria., auwal.tata@aun.edu.ng

Samuel C. Avemaria Utulu
Department of Information Systems, School of Information Technology and Computing, American University of Nigeria, Yola, Adamawa State, Nigeria., samuel.utulu@aun.edu.ng

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Auwal Alhassan Tata and Samuel C. Avemaria Utulu, Ph.D.
Department of Information Systems, School of Information Technology and Computing,
American University of Nigeria, Yola, Adamawa State, Nigeria.

Abstract: *There are conflicting views about how social enterprise logic impacts community networks' sustainability (CNs). Some authors believe that running with the social enterprise logic spells doom on CNs. Conversely, some believe that it does not necessarily spell doom on CNs. However, CNs, particularly those implemented in sub-Saharan Africa, cannot be implemented with an alternative logic, such as the for-profit business logic. Consequently, there is a need to develop a framework for making CNs sustainable, although they run with the social enterprise logic. This research develops a framework that will enable those involved in CN implementation in sub-Saharan Africa to understand how to instil sustainability factors into every stage of CN implementation. The study uses the Zaria Community Network (ZCN), Zaria, Nigeria, as a case study and adopts the inductive approach. The study data were derived from the chat messages from a WhatsApp group used as a platform for communication by those implementing the ZCN and from secondary sources. The study findings revealed that sustainable participation was a primary factor that comes to bear in the sustainability of the ZCN. It also revealed how sustainable participation influences sustainable infrastructure, sustainable stakeholders' support, and sustainable funding. We conclude that the framework helps implement sustainable CNs in sub-Saharan Africa and other regions with similar socio-technical similarities.*

Keywords: Sustainability, Sustainable Community Network, Social Enterprise, sub-Saharan Africa, Nigeria

1. Introduction

Information and communication technology (ICT) infrastructure is a physical system of telecommunications networks that transmit voice, video, and data using suitable telecommunications, information, and computing technologies (Okoli et al., 2010). Community networks (CNs) are locality based ICT infrastructure built to meet the information and telecommunication needs of the community where it is situated (Rey Moreno & Graaf, 2016). Telecommunications infrastructure is usually built by large telecommunication companies for businesses and profit-making. Patronage and return on investment determine to a large extent the locations telecommunication companies invest in and site telecommunication infrastructures (Fuchs, 2017; Gwaka et al., 2018). Conditions in low-income communities usually do not meet the profit-oriented criteria telecommunication companies use when siting their infrastructure (Fuchs, 2017; Micholia et al., 2018; Rich & Pather, 2020). The scenario leads to a digital divide where high-income communities in urban areas have access to excellent and reliable telecommunication infrastructure, while rural communities are either inadequately served or not served at all. The digital divide necessitates the implementation of CNs in low-income communities. It is assumed that CNs can help bridge the gap in the distribution of telecommunication infrastructure (Gwaka et al., 2018).

The history of CNs dates back to the mid-1970s in the United States when a group of individuals created a not-for-profit telecommunications infrastructure. The project aimed to allow free-shared access to the information services available on the shared ICT infrastructure (Carroll et al., 2015; Schuler, 1994). In low-income communities, CNs are usually created to improve the socio-economic situations of the people. CNs do this by providing the residents with access to relevant telecommunication and internet infrastructure (Rey-Moreno, 2017; Rey-Moreno et al., 2016). CNs extend modern telecommunications services to underserved and unserved regions of the world,

making such regions harness the benefits of having access to telecommunication and internet infrastructure (Zorina & Karanasios, 2017). It has been argued that CNs improve social capital in local communities (Abdelaal & Ali, 2007). There is also the belief that CNs can improve the quality of essential services delivery, such as health, education, and banking in remote and low-income communities (Rey-Moreno et al., 2014; Zorina & Karanasios, 2017).

CNs provide these functions even though they run with the social enterprise (SE) logic which does not allow them to use profit-making models to drive their sustainability (Bidwell & Jensen, 2019). Social enterprises focuse on activities that relegate economic gains for innovative solutions to social problems usually within local communities (Otola et al., 2021). Operating with the SE logic means that CNs rely on the goodwill of donors, volunteers and patronage of the residents in the host community (Micholia et al., 2018; Rey-Moreno et al., 2014). The SE logic requires that organisations operate with the not-for-profit logic (Powell et al., 2019). The implication is that organisations will have to provide goods and services at a cost not determined by market forces. In other words, organisations that run with the SE logic are usually designed to provide social services to the public. The social services are meant to promote social justice, material wellbeing, the common good, and social and economic development (Picciotti, 2017). This is why SE-based CNs are implemented in rural communities where telecommunication infrastructure is believed to be of critical need but less developed and compelling. In view of this revelation, running with the SE logic has persistent sustainability challenges to CNs in low-income communities (Gonzalez, 2016). Consequently, scholars believe that organisations that run with the SE logic can ensure sustainability by switching to the for-profit logic (Sabella & Eid, 2016). The belief notwithstanding, reports in the extant literature show that some CNs have endured sustainability challenges in low-income communities despite running with the SE logic (Rey Moreno & Graaf, 2016; van Stam & van Oortmerssen, 2010). This revelation implies that running with the SE logic does not necessarily spell doom for CNs in low-income contexts. The scenario shows that the extent to which stakeholders understand how the SE logic impacts CNs' sustainability is still questionable (Yim & Gomez, 2021). It indicates a need for a thorough investigation of the factors that determine sustainable CNs, how the factors emerge and how they can be managed. Our study was carried out to address these needs and was informed by the following research questions: *what factors ensure the sustainability of SE logic-driven CNs, how do the factors emerge, and how can sustainability requirements be integrated into every stage of CN implementation?*

2. Literature Review

CN is defined as an ICT infrastructure created by a group of people to achieve a defined goal. The goal could be to advance a cause, community socialisation, or serve as a testbed for testing a product or service (Schuler, 1994). Other scholars define CN as ICT infrastructure built and maintained by members of a community to meet their basic communication needs (Rey-Moreno, 2017). CNs in low-income communities are built to support basic ICT needs. The need for CNs arises due to the absence or inadequacy of telecommunications services in low-income communities. Telecommunication corporations do not foresee economic benefits in investing in low-income rural communities. This results in a wide gap in ICT infrastructure between low-income and high-income communities. The digital divide has become endemic in low-income rural communities in sub-Saharan Africa (Presens & Pather, 2020; Rich & Pather, 2020). CNs have been identified as interventions capable of bridging the digital divide in low-income rural communities (Bailey & Ngwenyama, 2011). The low-income status of the host rural communities makes it inevitable for CNs to operate with the SE logic. Operating with SE logic has primarily resulted in sustainability challenges for these CNs (Gwaka et al., 2018; Venkatesh, 2003). In a report on CNs in Africa, out of thirty-three identified CNs, only eighteen are active, with the remaining either classified as failed or are barely struggling to survive (Rey-Moreno, 2017). The failure rate is primarily attributed to sustainability issues (Chege et al., 2019).

There is, however, the challenge of adequately and appropriately defining sustainability among scholars (Fuchs, 2017). Over the years, the triple bottom line (TBL) of ecology, economy, and society has been used as the yard-stick to define sustainability (Rezaee, 2016). For instance, Jeronen (2013) proposes that sustainability projects into the future where environmental, societal, and economic considerations are mixed with pursuing a goal. Penzenstadler (2013) defines sustainability as preserving a system function over a specified period. The system function was further explained to be the maintenance and evolution of software systems with minimal impact on the environment, a sufficient economic balance, and well-managed knowledge. In the CN domain, Fuchs (2017) discussed the sustainability of CN based on environmental, economic, political, and cultural dimensions. He argues that the environmental dimension of CNs' sustainability has to do with regulating the amount of e-waste generated by CNs, given the exponential increase in the number of those that use them (Rey-Moreno et al., 2014). On the political dimension, sustainable CNs should be able to balance between being open and non-discriminatory and not to appear as a platform for the underworld to unleash their clandestine activities onto the world unanimously. On the cultural dimension, a sustainable CN should operate in such a way as to avoid internal division among its members that could foster internal power play. Economically, sustainable CNs should run a democratic, non-profit enterprise that can challenge the monopoly of large corporations. At the same time, it should have financial independence while providing network services that do not project the CN as a second-class service provider. Two fundamental conflicting points are visible in the explanations projected above. The first is that the not-for-profit logic skews CN towards SE ideology. Second, the financial independence logic pushes CNs towards commercial ideology where success is based on the profit made in favour of the enterprise.

The SE logic forces organisations to place the welfare of entire communities at the centre of their strategies and techniques. Organisations that run with the SE logic produce goods and services tailored to meet their host communities' needs (Picciotti, 2017). The practice of deploying ICT to meet the telecommunication and internet needs of low-income rural communities is driven by the obvious impacts of ICT on development in both rural and urban contexts (Olagunju & Utulu, 2021; Qureshi, 2015). It is, therefore, assumed that rural communities can benefit from the transformative ability of ICT if it is deployed strategically using the SE logic. SE logic was used in getting the rural community of Mankosi in South Africa to participate in efforts towards the sustainability of the CN build in the community (Rey-Moreno et al., 2015). However, observation of CNs' realities in low-income rural communities indicates that despite the claim that CNs run with the SE logic, they also engage in commercial activities to ensure sustainability. The commercial activities, in some cases, make them lose benefits from the privileges that SE-oriented organisations enjoy, e.g., rebates on licensing fees and taxes (Wheeler, 2017). The scenario questions how CNs can engage in commercial activities, given the need to ensure sustainability pertinently. The competing values resulting from the ways CNs run are at the centre of this study. The reason is that the competing values must be exposed and understood to know how they impact the sustainability of CNs in sub-Saharan African rural communities. The need to overcome the challenges that work against sustainable CNs in low-income rural communities in sub-Saharan Africa cannot be overemphasised (Rich & Pather, 2020).

Several studies have alluded to the criticality of community participation in the overall sustainability of SEs based ICT interventions (Carroll et al., 2011; Powell, 2011; Tapia et al., 2011). Being a SE, such initiatives rely on the goodwill of the local community they are meant to serve. Beyond providing the needed financial stability, the initiative relies upon community participation provides cheap and willing human capital for the continued service provisioning from the ICT artefact. For instance, in quantitative work, Abdelaal and Ali (2009) stressed the importance of community participants in the take-off and sustainability of community wireless networks. It considered the tangible and intangible contributions from community participants towards building CNs and concluded that community participation is central to the sustenance of CN. Powell (2011) stressed

the importance of community participation from the design stage for the effective sustainability of CNs. Kuchibhotla et al. (2013) established that the sustainability of a university-led CN depends on community participation. The impact achieved by such CNs depends mainly on the collective action of the university community in terms of financial and technical contributions and their volunteering acts towards running the CN. All these point to the overbearing impact community participation has on the CN's overall sustainability.

The lack of an actionable framework derived from empirical studies has a meaningful impact on practitioners' ability to design, implement and run sustainable CNs. Activities leading to the implementation of a CN in a low-income context usually start with a group of people identifying the need for a CN to solve socio-economic and political challenges in the community. Funders are identified and engaged in financing the CN initiative. Various stakeholders who will contribute to the CN's success and sustainability are identified and convinced to commit to the project. The planning and deployment of the CN take place with the involvement of all stakeholders. While this may sound simple, it requires concerted efforts to mobilise and coordinate different groups of people. Stakeholders that are not members of the community having essential expertise needed to operate the CN are expected to participate in its operations to train community members committed to the CN's day-to-day operations. The external stakeholders are expected to gradually withdraw their support as the local stakeholders gain the expertise to operate the CN. Unfortunately, there is a dearth of actionable, practical knowledge that explicates how this array of practical activities can be completed to ensure the sustainability of CNs. The study seeks to fill this knowledge gap. In other words, the study aims at two important contributions, namely, theoretical and practical contributions, that provides insights on how SEs like CNs that were established to promote development can be made sustainable.

3. Research Context

Zaria community network (ZNC) was initiated by the Nigeria chapter (ISOCNG) of the Internet Society (ISOC). The ISOC is a non-governmental body established to advance the use of the Internet for development globally. Those working for the ISOCNG are mostly volunteers and live outside the Zaria community where the ZCN is implemented. ZCN was initially designed to provide a collaborative platform for fourteen higher educational institutions (HEIs)/agencies in Zaria. The idea was, however, dropped. The new objective of the ZCN was reviewed to include extending digital infrastructure into two rural communities, two market communities, and one educational agency. This implies that the ZCN will consist of five stations. It will also consist of two base stations as the control centres for the five remote stations. ISOCNG initiated the change in the original plan of the ZCN without considering the sustainability issues connected to it. In the initial plan, the community members were people from academia with relatively sound ICT backgrounds. Getting their participation in the implementation and management should be relatively easy. However, the change brought in new entrants that presented new challenges such as level of education and ICT awareness on how they view the need for ICT and its overall effect on their daily activities and what will drive them to want to key in into ZCN.

Nevertheless, two of the project locations were completed with educational content provided as a network service. The educational content is hosted on an offline server located in the base station in the university ICT centre in Zaria metropolis. The whole idea is to minimise the need for internet access. The deployment of the remote sites was carried out without community participation. However, volunteers from each of the host communities are expected to take over the management of ZCN when the initiators (external volunteers) decide to leave. How will the right set of local volunteers be identified and recruited to sustain the CN services? What will be their motivation to want to invest their time in a project they know nothing about? This perhaps is why there is no

utilisation of the services two years after completion. Deployment of the remaining stations was put on hold pending the attainment of the planned utilisation rate.

4. Methodological Assumptions

The qualitative research design was adopted for the research. The qualitative research design is based on qualitative data such as texts, audiovisual contents, and any other non-numeric data for research data during a study (Myers, 1997; Stepniak, 2019). Researchers generally believe that research studies carried out with the qualitative research design data are usually subjective (O'Flaherty & Whalley, 2004). The research also adopted the inductive research approach, which allows extensive data collection for analysis that results in formulating a theory or framework that will give an insight towards answering the research questions (Saunders et al., 2011). The approach is different from the case where literature review provides the basis for theory building (Utulu et al., 2013). Interpretive research philosophy was adopted as the research paradigm. Interpretivism embraces the stance that human actors' reality is a social construction (Walsham, 1995). The social world of people is built upon subjective and shared meanings composed of an internal logic that must be understood. Research studies based on the interpretive stance look for subjective meanings constructed by social actors within the research context(s). Interpretivism endeavours to acknowledge, understand and interpret phenomena within research contexts based on the subjective meanings assigned to them by the social actors whose everyday life is embedded in the realities within the social contexts (Goldkuhl, 2012; Kroeze, 2011). This implies that the realities in the sustainability of ZCN are subjectively created by the array of social actors involved either directly or indirectly in its implementation (Utulu & Ngwenyama, 2017).

The case study research method was adopted for the study's research method. A case study allows for an in-depth study of a phenomenon in its natural context. It is valuable for developing and refining concepts for further research (Cavaye, 1996). The case study research method can be categorised into single and multiple case studies (Gustafsson, 2017). In particular, the single case study research method was chosen because it allows for a comprehensive analysis of a phenomenon within a context with a comprehensive and detailed analysis of its organisational dynamics (Doolin, 1996). The implication for choosing the single case study research method is that it allowed a thorough analysis of the factors that affect the sustainability of ZCN and how the factors emerge. The research adopted participatory observation and texts messages generated through a WhatsApp group as the qualitative data collection techniques. One of the researchers was a member of the executive council of the ISOC NG, the non-governmental organisation working to implement the ZCN. He implemented participatory observation given that he participated in most meetings and visitations to Zaria and other places that the ISOC NG visited as part of the activities for implementing the ZCN. He took field notes on his observation during the participatory observation. The implementation team adopted the WhatsApp application, a social media platform, as one of the media for facilitating communication and interaction during the implementation of the ZCN. The communication and interactions done on WhatsApp constitute the qualitative data used for the study (Andreotta et al., 2019; Kaufmann & Peil, 2020).

The entire stream of the conversation was exported to Microsoft Word and documented as primary research data. It is important to note that the communication and conversations were made without the intention that they would be used for a research study. It follows that using the WhatsApp data has a peculiar advantage given that it is devoid of biases that may come up when research participants are aware that they are being interviewed for the sake of a research study. Another source of data used for the study is the report blogs the ISOC NG has on its official website. The information on the blog was read many times to understand their content to come up with the themes used for the study and incorporate them into data collected from the WhatsApp group. Thematic Analysis was used to analyse the data. According to Braun and Clarke (2012), Thematic analysis

identifies commonalities in how a topic is written or discussed while trying to make sense of the commonalities. This constitutes a form of document analysis. It can be used in collaboration with other research methods for triangulation (Bowen, 2009), and it can also be used as a standalone research method (Mackieson et al., 2019). Atlas.ti software was used for the data analysis technique. To ensure that every ethical requirement for the study was met, a permission request mail was sent to the Internet Society, Nigeria (ISOCNG). The mail detailed the study's requirements and objectives. It expressly indicated that the way the WhatsApp group discussion and other secondary data would be used for the study. The ISOCNG granted permission for the study to be carried and the WhatsApp group discussions and other secondary data can be used.

5. Findings And Discussions

5.1. Sustainable Community Participation

The study's objective was to expose and understand sustainability issues in the implementation of the ZCNs in Zaria, Nigeria. It is assumed that the study will enable us to propose a framework for understanding how to implement sustainable CNs in sub-Saharan Africa. Consequently, our findings reveal that sustainable participation is the key factor that would have promoted the sustainable implementation of ZCN. In the context of the study, sustainable participation ensures the intergenerational involvement of members of the host community in every stage of the ZCN implementation. Intergenerational involvement of members of the host community ensures that the present generation's involvement in the pre-implementation, implementation, and post-implementation stages does not have adverse effects on the involvement of upcoming generations in the continuous sustainable implementation of the ZCN project. It follows that the sustainable participation of members of the host communities is likely to enable them to have a positive disposition towards the ZCN. The positive disposition can help generate a positive intergenerational disposition towards the ZCN. Sustainable participation can also enable members of the host communities to acquire the requisite skills and knowledge required to actively take part in the ZCN management. This is important because it is enshrined in the ZCN implementation plan that the centre will be handed over to the host community after a while. Another reason why sustainable host community participation is essential to sustainable ZCN implementation is that the ZCN is supposed to run with the social enterprise logic.

Our findings show that the ZCN implementation team had identified sustainable community participation as the primary sustainability factor in the ZCN project. Consequently, the team focused on mapping out how to achieve sustainable host community participation. One of the actions to be taken by the team is the roadshow. The roadshow was supposed to sensitise members of the host communities on the importance of the ZCN implementation and the relevance of their support and participation. A member of the implementation team posits that the *"reason we decided to get stakeholders to buy-in before hardware deployment is to make sure we don't go the way of the donor/interventions approach where CNs are deployed and expected users do not care about it or know enough about it (sic)".* The grant application document developed by the ZCN implementation team stated the importance of the roadshow to ZCN implementation as it "*facilitate the engagement of the representatives of the educational institutions, district heads, culture custodians, youth groups and the general public in order to recruit their support. It will enable stakeholders to buy-in and make them aware of the Internet Society, the Internet and the (Community Network and Culture Hub) project and to attend demonstration sessions and town hall meetings"*. The strategy was to get "*the department of theatre art to drive that [the roadshow] because we felt they had the requisite expertise to be able to deliver the message in the form of drama. So we are in talks with [PA]"*.

The roadshow was to be used to increase the number of people aware of the ZCN project and, in effect, the number of those that will participate in its implementation. The implementation committee also thought that the roadshow could help them to increase the number of people that

will be available to be selected to join two committees that were to be established to manage the implementation of the ZCN. The committees were the technical committee that oversees all technical operations and the management committee that sees to the ZCN administration. Another advantage that would have been derived from the roadshow is that it would have enabled the formation of committees that comprise both local and external volunteers. Local volunteers are members and residents of the host communities, while external volunteers would be drawn from ISOCNG members involved in the projects as implementation team members. The combination of both external and internal volunteers would have facilitated knowledge and skills transfer from external volunteers to the local volunteers and vice-visa. Cross-cultural knowledge and skills transfer are germane to achieving the ZCN implementation goal. It could have been helpful to the planned strategic transfer of the operations and management of the ZCN from external volunteers to local volunteers over time.

Unfortunately, the efforts made by the ZCN to implement the roadshow did not yield the expected results. The failure to carry out the roadshow also resulted in a situation where the town hall meeting was not held. This is given the low awareness level among members of the host communities. The inability to actualise the two awareness campaigns made the implementation team move on with deploying the technical infrastructure to power the ZCN. However, the implementation team knew the implications and hoped that they would revisit the roadshow sometime in the future and, in effect, town hall meeting. One of the implementation team members argues that *"Of course the town hall and roadshow will happen but we shouldn't wait until that milestone is completed before we move to deployment (sic)…can we look at deploying one base station and one node soon? I mean without waiting for the roadshow and stuff? It's been one year plus and it's now looking as if in the bid to do it perfectly, we may end up not doing it at all"*. One lesson revealed here is that sustainable participation is complex and time-consuming. Therefore, concerted efforts must be put in place to ensure that it is done.

Consequently, our observation shows that the inability of the implementers to hold the roadshow and town hall meeting was the first major setback towards sustainable ZCN. It deprived local community members of the opportunity to participate first, at the pre-implementation stage and, in effect, other equally essential implementation stages of the ZCN project. A long-term effect of this is that the lack of participation will also deny members of the host communities the opportunity to acquire the knowledge and skills they need to run the ZCN if it is completed and handed over to them. The absence of community participation has also deprived the locals of the opportunity to be involved in determining the services the ZCN would consider important and primary digital and information services to be rendered to the host local communities.

5.2. Sustainable Infrastructure

The infrastructure to be deployed by the ZCN comprise the hardware, such as antennas, masts, switches, routers, battery banks, solar panels, inverters, and computers. It also includes all the underlying software and protocols required to set up the network and provide the needed services to the host communities. The infrastructure deployed by the ZCN can be said to be sustainable if its deployment and maintenance can be jointly handled by members of the host communities and external volunteers working for ISOCNG. Usually, advocating for the joint deployment of infrastructure during CN implementation is complex, given the scarcity of expertise in host local communities. However, the complexity can be handled if a concerted effort is made to systematically promote the involvement of members of the host local communities. This can be achieved if programs that can foster skills acquisition/transfer from external volunteers to interested and qualified members of the host local communities are implemented. If skills acquisition/transfer from external volunteers to qualified members of the host communities is achieved, the possibility for the ZCN to enjoy low infrastructural deployment and maintenance will be high.

Moreover, this is very important to the ZCN sustainability given that it is designed to run with the SE logic. Our findings show that the team was aware that sustainable infrastructure depends mainly on how technical skills and knowledge to deploy and maintain the infrastructure meant to run the ZCN are transferred from external volunteers to local volunteers. Our findings also show that external volunteers had workload pressures and competing responsibilities that made it difficult for them to focus on the deployment of infrastructure for the ZCN. One of them reveals: *"Because we all have work pressure now and then, elections, holidays, etc, we have spent over a year talking and planning for the Zaria CN and Culture Hub. If care is not taken, we will lose the opportunity to help several other communities build networks. This is why I thought we should use this group to jump ahead to the infrastructure deployment part".*

ZCN infrastructure is supposed to be composed of two central stations located within the premises of a university in Zaria. There are also the six-remote stations that are to be connected wirelessly to one of the base stations to access network services. Each remote station also provides wireless access to network services to serve the communities. Part of deploying the infrastructure is the identification of suitable physical locations for deploying the remote stations. We gathered through observation that the team only involved the head of the host communities. Our observation was corroborated by information derived from the WhatsApp group chat where a member of the implementation team stated: *"In Basawa ,same as Bomo, the Chief was so happy and we went round [with hime] to identify a location".* Unfortunately, the youths in the host communities visited to secure physical locations where infrastructure is to be installed were not involved. An adjoining challenge is that some of the youths left out possess basic ICT literacy and skills that would have been useful in attaining sustainable infrastructure deployment. Sustainable infrastructure deployment here means a situation where youths in the host communities are involved in the infrastructure deployment process, learn more skills, and maintain the infrastructure when handed over to them by external volunteers. Involving the youths would have also helped improve on the security of the infrastructure when it is deployed. We assume here that the sense of ownership which could have been entrenched among the youths would have promoted their involvement in the security of the infrastructure. Data derived from the chat group indicate that the implementation team understands the role youths could play in securing the installations: *there are some business centers around the area and its like [the] center for the youth of the area, there is a [military outpost with a] tank and there is security personnel around (sic)".* We observed that youths were involved in many activities, sports, and businesses in the area, which meant they were always there and could help secure the area. An interesting part of our findings is the relationship between sustainable participation and sustainable infrastructure deployment. Issues regarding the inclusion of youths in discussions and how to leverage knowledge and skills required to deploy and maintain infrastructure all evolved from the non-implementation of sustainable participation.

5.3. Sustainable Funding

The primary source of funding for the ZCN, given that it is expected to run with the SE logic, is a 'seed fund' that comes through grants provided by ISOC International. Other sources of funds are secondary and include the assumed sales and payments made by those who patronise the ZCN. This means that there is the likelihood that the ZCN may face financial challenges when the grants are stopped. There is a clause in the agreement reached with ISOC International on the duration of the funding that it will provide to support the ZCN. Once this happens, the ZCN will have to generate the funds to ensure its continued operation. The scenario raises a question on the sustainability of the funding source for ZCN. Sustainable funding is taken to be the ability of the ZCN to raise funds that will ensure its continuous operations.

Given the nature of the ZCN, we observed that the most desirable way it could achieve sustainable funding is its ability to ensure that members of the host communities patronise its services. Given the array of services it is supposed to provide, a member of the implementation team posits that the

"*seed funding mainly came from ISOC. Some other funders (sic) pledged internet services while some pledged their expertise*". Our findings also revealed that not all the pledges were redeemed. The scenario resulted in the reduction of the running budget. A member of the implementation team indicates: *"Of course, as the funding was trimmed by the funder, we had to trim the budget as well"*. There are many possible reasons why organisations that pledge to support the implementation of the ZCN did not redeem their pledges. First, the team seems to have exhibited a lack of commitment to implementing a pledge redemption program. Another possible reason is that organisations providing funds may have held back some of the pledges to observe how effectively the implementation team utilises the funds released. Irrespective of the reasons, it is important to note that the situations surrounding the funding of the ZCN portend a critical challenge to its sustainability. Therefore, it means that there is a need for its implementation team to consider how the ZCN could initiate sustainable funding.

Observation shows that sustainable funding was not achieved because available resources were not utilised to provide the services which the local host community indicated they would like the ZCN to provide. A member of the implementation team suggested that during a visit, members of the local host communities complained that the ZCN is not providing the types of services they think they need. It follows that the members of the local host communities preferred to have access to the Internet, whereas the ZCN plan did not include providing internet access due to the non-availability of adequate funding. Consequently, there were alternative plans for the ZCN to provide offline educational services. Thus, another implementation team member noted that *"Regarding content, MIT OCW and offline Wikipedia are easy wins for us while other content is sourced.*" Again, sustainable participation seems to bear in the ways sustainable funding was presumed in the study. Sustainable participation would have helped the implementation team to have a solid plan for generating funds through the patronage of the members of the local host communities. To achieve this, the members of the local host communities needed to have been carried along as the plans to implement the ZCN unfold. The problem with understanding and providing the services members of the host communities need is also a function of the extent of participating members of the local host communities. Consequently, our findings also indicate a relationship between sustainable participation and sustainable funding.

5.4. Sustainable Stakeholder

Two basic types of stakeholders were involved in the ZCN implementation, namely, external and internal stakeholders. External stakeholders consist of a group of people that are not part of the local host communities. On the other hand, the internal stakeholders are members of the local host communities. The external stakeholders are usually considered experts in various fields and work as volunteers in the ZCN implementation team. Internal stakeholders are the local people who are the needs and sometimes the zeal towards enhancing their socio-economic status by using the ZCN. While the external stakeholders contribute skills, the internal stakeholders provide contextual insight into the community's needs. The synergy is important for ensuring the ZCN's sustainability and helps it contain and manage the challenges attached to its running with the SE logic. The motivating factor for each stakeholder group depends on its vested interest. So it is pertinent that stakeholders have an avenue for engagement and collaboration to ensure the incorporation of their interests into the more extensive plans. This ensures the continued commitment of each stakeholder group to the macro interest of the group. Those who prepared the grant application were aware of understanding and providing avenues to ensure that all stakeholders' needs were catered for. The grant application document posits: *"We recognise the importance of having the buy-in of the target community at all levels; from the Heads of Institutions to Faculty members to Network Engineers and local traditional figures and the youth. We will be relying heavily on community engagement to involve multiple stakeholders and increase the project's chances of success".* Inquest into the objective of the ZCN project as contained in the original grant application reveals that the "*project seeks to network a cluster of research and education institutions; In addition to Internet access for students and*

researchers, the resulting Community Network will provide affordable access to locally-hosted teaching and learning resources". However, the objective was changed to serve the ICT need of low-income communities in Zaria. The reason for the change, according to the chapter president is to *"increase the number of public locations and reduce number of institutions (covered in the project funding) If we see really viable public locations that would impact more people, it would be better than tying down equipment at some office where they resume at 10 and close at 3 and it is only 20 people on staff there".* As excellent as this modification was, the implementation team needed to reconstitute the stakeholder group to reflect the new reality. Unfortunately, this was not done. As earlier mentioned, the agreed means of collaboration for the stakeholders in WhatsApp's social media platform. A look into the group's membership indicates that the membership is not a true reflection of the stakeholder groups. It is most likely that deliberations and decisions will be skewed towards meeting the interest of stakeholders having representation in the group. Our observation shows that the membership of the WhatsApp group has over 90% of people from academics. This explains why the decisions on services to be rendered on the CN are skewed towards academic content. More so, the composition of the WhatsApp group reflects a bias towards the external stakeholders. As good as the services implemented might be, it will likely not appeal to the internal stakeholders. Despite this, we observed that members of the local host communities still had an interest in the ZCN project. A member of the implementation team revealed on the WhatsApp group: *"Chairman of the association of phone repairs and sellers… welcome the [ZCN implementation] idea. In fact. they have been calling to know when we are coming to start, we have identified a location which they promise to talk to the owner of the building for permission to use the building as our station."*

Further engagement would likely secure the commitment of a willing internal stakeholder group and expose the team to more stakeholder groups that will lead to sustainable stakeholders. Of interest to the issue of sustainable stakeholders is the sustainable participation of necessary stakeholders. It follows that if concerted efforts were made to outline and map out how to achieve sustainable participation of all stakeholders, the challenges faced at the point of ensuring sustainable stakeholders would have been solved.

6. Theoretical Elaboration

Community Participation, sustainable infrastructure, and sustainable Community network

Our study of the extant literature shows that several frameworks have been used to explain how ICT4D such as SE-based CNs, can be made sustainable. For instance, Rich and Pather (2020) used the People-Technology-Organization-Environment (PTOE) conceptual framework to identify the salient factors that come to bear for the sustainability of the ICT4D initiative in a low-income context. However, the framework could not provide for how these factors interrelate to ensure sustainability. In earlier work, Rey-Moreno et al. (2014) emphasised the importance of a sense of ownership to the overall sustainability of CN in low-income communities. Borrowing from the social psychology model, he used the model of psychological ownership to outline approaches for instilling a sense of ownership of externally initiated CN through community participation. Despite being operational, his solution likely downplayed other factors at the expense of operationalising community participation through a sense of ownership of a CN.

Scholars have yet to provide a framework that shows the emergence of factors that come to bear in achieving a sustainable SE-based CN in a low-income context. Nonetheless, scholars have alluded to the importance of community participation in achieving sustainable SE-based CN. The scenario presents a situation where stakeholders do not have a theoretical and practical knowledge of operationalising this assertion. One of the most important requirements for a successful SE-based CN is the identification of volunteers that will commit to processes that sustain the operations of the CN. This process is then backed up with a plan to replace the volunteers when the need arises for them to move on (Hopkins, 2005). However, the study has not been able to provide actionable ways

of sustaining this volunteer cycle. In another paper, the involvement of local volunteers from the design stage is a stimulus to the sustainability of the CN, especially those externally initiated. This, however, will require that community members view the CN as a solution to some of their social, economic, and political needs (Rey-Moreno et al., 2014). Volunteering to install, operate, and maintain CN infrastructure ensures that services are rendered sustainably. This makes the CN a training ground for nurturing younger volunteers towards managing the infrastructure. A backup of willing volunteers learning and getting ready to replace older ones on the verge of moving on in life creates a scenario we term sustainable infrastructure (Baig et al., 2015). As earlier mentioned, SEs rely heavily on the goodwill of the general community. It then follows that the ability of the CN to continue to appeal to members of the community in a manner that there is a constant supply of volunteers to continue managing the common good depends very much on the CN's ability to enhance their social capital. This makes it imperative that infrastructural design be grounded in community needs and consensus. The idea that community participation can be sorted post-implementation harms the sustainability of a CN (Shin & Venkatesh, 2008). Given the revelations in the extant literature and our study, we propose:

P1: Sustainable participation will likely create sustainable CN infrastructure that invariably leads to sustainable CN.

Community Participation, sustainable stakeholders, and sustainable community network

To ensure the sustainability of CNs operating with SE logic, public engagement practices such as discussion groups and public consultations get established to enhance awareness and interaction between different interests (Crabu & Magaudda, 2018). The engagements transcend seeking representation to intervention that brings to bear the peculiar need of each group into the implementation of community information and telecommunications systems such as a CN. Several researchers have underscored the importance of this stakeholder engagement in the overall sustainability drive. In one participatory research that described the growth of a highly successful CN in the United States of America, the success of the CN was attributed to an evolving and growing stakeholder participation. A particular group of stakeholders initiated the CN to meet their needs. Achievements of the CN soon attracted more community participation with diverse goals. Integration of the diverse goals resulted in a sustainable CN that is multi-stakeholder (Carroll et al., 2011). In another research in rural South Africa, ethnography was used to gain insight into their sustainability drive. Being an externally initiated CN, the initial effort to get community participation was challenging. Advocacy towards understanding community needs and awareness campaigns in the community improved utilisation. The resultant expansion of community participation saw increased need requests for integration onto the network (Rey-Moreno et al., 2014). It is then likely that community participation has fostered an increase in stakeholder participation in CN with their attendant request for their needs to be integrated onto the CN. Achieving this integration could further enhance confidence in the CN as a development tool in the community. Sufficient to say:

P2: Sustainable participation improves sustainable stakeholder support, likely resulting in a sustainable community network.

Sustainable participation, sustainable funding, and sustainable community network

Funding for a SE in a low-income context often takes the form of grants from governments and non-governmental bodies. Limited by a finite lifespan, grants do not constitute a sustainable funding model for the continued existence of SEs. It then becomes imperative that a sustainable means of funding is identified for the continued operation of the CN(Radovanović et al., 2020). Given dwindling resources, extant literature has produced conflicting models for the sustainability of SEs. While some researchers believe that social enterprises need to embrace profit-making ideologies, some researchers are inclined towards holding onto the subsistence ideology (Jenner, 2016). Despite the low relative growth rate compared to the for-profit businesses, not-for-profit is beginning to

show tremendous success by adapting to new business models such as crowdfunding (Matthews, 2021; Picciotti, 2017). This is in tune with our claim that community participation will likely foster sustainable funding for CNs in a low-income environment. It suffices to say that continuous collaboration with the local groups and individuals is likely to bring to light areas of collaboration between the CN management and the community. A likely alliance where the different groups collaborate with the team to mould CN services to their needs is formed where the CN gets sustainable funding while the community gets its desired services. A review of sustainability strategies of some African CNs shows that Tunapanda in Kenya achieves economic sustainability from capacity building and internet services provisioning (Radovanović et al., 2020). Zenzeleni in South Africa achieves financial stability through low-cost Internet service provisioning. The CN can survive competition from large corporate providers because of the tax and licensing rebate it enjoys from the government. The rebate is made possible by its social enterprise status (Rey-Moreno et al., 2015; Takavarasha Jr et al., 2018). A critical look at these scenarios reveals that an understanding of the community's needs guided the implementation of the CN. The community invariably sees itself as an important stakeholder of the CN, thus ensuring its sustainability. However, community participation is a huge issue, especially for CNs in low-income communities (Banda & Chigona, 2017; Farao et al., 2020).

In Nigeria, two CNs are prominent. The Zaria Community Network (ZCN) and Fantsuam Community Wireless Network (FCWN) in Kafanchan are all located in Kaduna state's low-income communities. Both CNs run with the SE logic. While so much insight is available for FCWN (Comfort et al., 2003; Dada, 2018; Dada & Comfort, 2008; Johnson et al., 2003), the same cannot be said about ZCN. It is likely that while FCWN has attained a stable sustainability status, ZCN seems to be failing.

In this regard, we propose:

Sustainable participation will likely result in sustainable funding that results in a sustainable SE-based CN. A conceptual model derived from the findings is presented in figure 1.

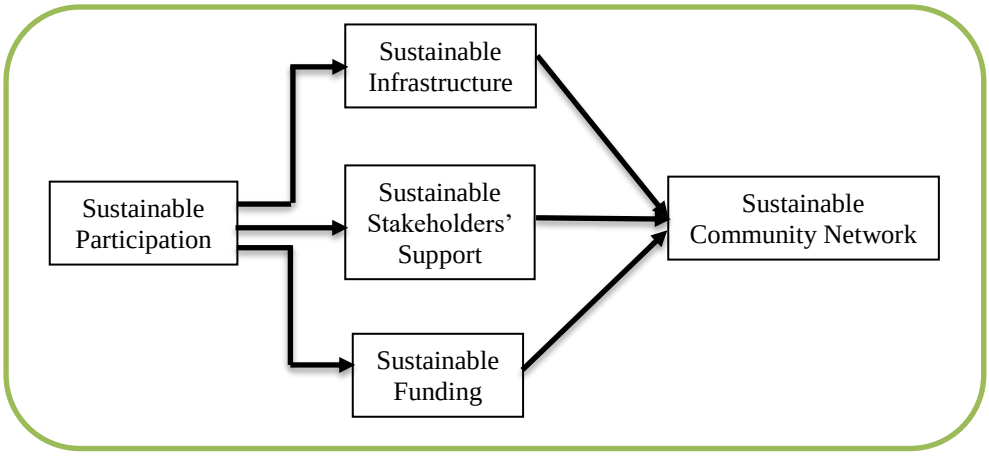

Figure 1: Conceptual Model of Sustainable Social Enterprise Based Community Network

7. Conclusions And Limitations

The study identified community participation, sustainable infrastructure, sustainable stakeholder support, and sustainable funding as the factors that come to bear in aiming for a sustainable SE-based CN. Most externally initiated CNs are usually implemented with a few enthusiasts in the community with the expectation that the community will eventually buy into the project with time. However, we have shown that such a model usually fails as it portrays the CN as a privileged

infrastructure belonging to the enthusiasts and their external collaborators. We have identified that such CNs need to adopt SE ideology for sustainability. Adopting this ideology infers that the community needs to be involved right from the design stage of the CN so it can instil a sense of ownership in the community. We explained the interconnection between community participation, sustainable funding, sustainable stakeholder support, and sustainable CN. We observed that the ZCN network's problem regarding the transfer of ownership would have been avoided if the team had involved the local community right from the design stage. We have shown that this single act of community participation will bring about sustainable infrastructure as there will be ready-made volunteers to manage the infrastructure at all times continuously. It will also lead to an evolving composition of stakeholder groups as every group in the community will start to explore ways to take advantage of the CN to achieve their goal. Finally, community participation will also lead to sustainable funding because the community will feel obliged to patronise the CN for its desired services continuously. As a limitation, this research did not consider governmental policies to the overall sustainability of the CN. Some researchers have established that the dynamics of government policies do have a telling effect on SE. It is thus likely that it can also affect CNs with SE ideology. Another limitation is the effect of disruptive events such as epidemics. This research period coincided with the start of the COVID 19 pandemic. The effect of activities surrounding the pandemic management on the sustainability of ZCN was not included in the research. These form bedrock for future research that could result in a holistic model that describes the dynamics of sustaining a CN with SE logic.

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