An assessment of the sustainability of Living Labs in Kenya

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Abstract

Purpose – There has been a high rate of failure among the Living Labs in Kenya resulting in the expected outcomes not fully realized. This paper aims to assess the sustainability of Living Labs in Kenya.

Design/methodology/approach – Based on the four capital method of sustainable development evaluation framework, data were collected through interviews and questionnaires from innovators, users and employees among the 25 living labs in Kenya.

Findings – The research found that some innovators are not familiar with the living labs, the living labs are innovative and prepared to survive in future, some labs have strategic plans on how to pursue future environment and have developed ways of choosing right people to incubate, inability to get enough funding from the host organizations and limited knowledge on the supervision level of the operations. A model is proposed that can be generalized to other living labs in developing countries.

Research limitations/implications – The study was done in Nairobi where most of the living labs are situated.

Practical implications – The study concludes by emphasizing on the user involvement during innovation process. There is need to expand the capacities of living labs to accommodate more people to ensure more innovations are supported at a time. The senior managers in charge of the living labs should increase the level of supervision to ensure that the labs are effective in their incubation efforts and institutionalize support of the host organization to the labs to ensure continued growth and expansion.

Originality/value – The findings of this study are of value to research community, the decision and policymakers as it seeks to document the current status of the living labs in the Kenya

Keywords Sustainable innovation, Living labs, Innovation ecosystem, Innovation lab, Innovation space, User-driven innovation

Paper type Research paper

1. Introduction

A Living Lab is a user-centered, open innovation ecosystem, that operates in a territory that can be regional, national or global, integrating concurrent research and innovation processes (Schumacher, 2013; Salminen, Konsti-Laakso, Pallot, Trousse, & Senach, 2011). A Living Lab is a place where experts work, deploy, develop and test in the living environment (Veeckman, Schuurman, Leminen, & Westerlund, 2013). The Living Lab concept is guided by the principle of co-creation, exploration, experimentation and evaluation of innovative

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ideas, scenarios, concepts and related technological artifacts in real life, which involve user communities not only as observation subjects but also as a source of creation. Living Labs tend to function at the low and mid-level innovation levels, use context based experience to develop new products and services, and are focused on exploration and exploitation (Almirall & Wareham, 2011).

Cunningham and Cunningham (2016) noted that the reality, in a developing country context, was that establishing and maintaining Living Labs was challenging and relatively expensive. This explains why many Living Labs have proven to be unsustainable once seed or donor funding was no longer available. Innovation spaces have gradually gained grip in African countries as a result of emergence in technology and growth in ICT entrepreneurship (Cunningham & Cunningham, 2016).

There are 25 Living Labs in Kenya most of which are funded by the donors (Cunningham & Cunningham, 2016). However, there has been a high rate of failure, thereby expected outcomes are not fully accomplished (Schumacher, 2013; Veeckman et al. (2013). The failure can be attributed to poor project design and management. Cunningham and Cunningham (2016) found that most Living Labs are not sustainable. Sustainable development is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs (World Commission on Environment and Development, 1987). The experience in Kenya is that most living labs fail before their objectives are fully achieved.

This research sought to find out why the Living Labs in Kenya are not sustainable. The research determined the innovation outcome of Living Labs with regard to their sustainability in Kenya, identified the support and operational structures in Living Lab sustainability and the innovation approach for the sustainability of Living Labs. A framework that can be used to assess the sustainability of Living Labs is proposed.

2. Related works

2.1 Sustainability of living labs

A Living Lab for Sustainable Development (or Sustainability Living Lab) is a research approach aimed at open socio-technical innovation processes, in which users as well as relevant actors of the value chain and the utilization environment participate in the development and application of new products, services and system solutions (Welfens, Liedtke, & Nordmann, 2010). Sustainability is a prerequisite for any product or service (Cunningham, Herselman, & Cunningham, 2012; Liedtke, Jolanta Welfens, Rohn, & Nordmann, 2012). Living Lab practitioners can work towards a more sustainable way of setting up labs that can run innovation projects over a longer period of time. Hilty, Lohmann, and Huang (2011) argue that a combination of efficiency and sufficiency strategies is the most effective way to stimulate potential to support sustainability. However, the majority of Living Lab projects still continue to be funded by donor agencies and multinationals and face many challenges (Ali & Bailur, 2007).

For a Living Lab to succeed, there must be an effective management in the definition, design, development and validation of new products and services that maximize the socioeconomic conditions of the partnership (Guzmán, del Carpio, Colomo-Palacios, & de Diego, 2013). Establishing sustainable partnerships of stakeholders with a shared set of values is a strategic step in the planning and preparation phases of Living Labs. The critical aspects of the business model employed is important for the success of open collaborative innovation to foster rural and regional development (Schaffers et al., 2007). Organizations adopting a sustainability business model, where sustainability concepts shape the driving

force of the firm and its decision-making, must develop internal structural and cultural capabilities to achieve organization-level sustainability (Stubbs & Cocklin, 2008).

The innovation process is guided by sustainability criteria and aims to contribute to production and consumption patterns that can be applied on the global and long-term scale and are inter- and intra-generationally viable. The Living Lab approach that involve the end-user in the process of problem identification, technology design, implementation and evaluation has been used by various authors (Baelden & Van Audenhove, 2015; Leminen & Westerlund, 2012; Liedtke et al., 2012). By integrating users and other relevant actors early on in the innovation process, chances for the diffusion of innovations and their appropriate use are improved (Baedeker, von Geibler, Jordan, Rohn, & Liedtke, 2012). This will gain insights into the local context and ensure a user-centric approach that benefits from adopting participative practices. The integration of users as co-producers in product development is critical and a practical way of encouraging open innovation (Salminen et al., 2011; Leminen & Westerlund, 2012).

2.2 Role of living labs in Africa

Living Labs have the potential to address Africa's socio-economic and developmental needs; it is therefore important to have a deeper understanding of the key role of Living Labs in the continent. In an African context, Living Labs have emerged primarily as outputs of action research with the key dimension of addressing challenges in relation to rural socio-economic development and sustainable quality of life (Cunningham et al., 2012). Living Labs Networks in Africa provide an important opportunity to collaborate, co-create, prototype and test new products and services, technologies, processes, business models or ideas.

The Living Lab approach can be an open-innovation methodology for the development of context-based sustainable ICT4D solutions and hence contribute to the development of rural Africa (Ntawanga & Coleman, 2016; Gumbo, Thinyane, Thinyane, Terzoli, & Hansen, 2012).

In South Africa, where Living Labs have been successfully running for several years now, there is an emphasis on the co-creation with communities, specifically rural communities (Coetzee, Du Toit, & Herselman, 2012).

In Europe, on the other hand, the concept of Urban Living Labs focuses on low carbon cities (Voytenko, McCormick, Evans, & Schliwa, 2016), Smart Cities (Komninos, Pallot, & Schaffers, 2013), active campus environments for teaching and learning (Evans, Jones, Karvonen, Millard, & Wendler, 2015), among others.

Grezes, Fulgencio, and Perruchoud (2013) address the issue of economic sustainability and business model research in the collaborative configuration of African Living Labs and recommend that economic sustainability might be achieved by positioning Living Labs as a collaborative organization, social innovation agent and a social business. (Smit et al., 2011) evaluated the selection of stakeholders and their role in developing a Living Lab concept within a project and found that the innovation process and user involvement are important criteria for a successful Living Lab.

In Tanzania, Hooli, Jauhiainen, and Lähde (2016) found that Living Labs create new entrepreneurial skills and opportunities for people with limited formal education, the participants discuss and define local challenges in groups and find solutions through co-creation, and communities combine local knowledge and practices with external ones.

Innovation is increasingly taking place in cross-border collaborative networks. Schaffers and Turkama (2012) argue that Living Labs can form collaboration networks to support small firms and other actors to engage in cross-border collaboration and to accelerate the development and acceptance of innovations. However, adopting the Living Labs networking approach in Africa requires thorough understanding of each party's objectives and drivers,

the alignment of operational processes, establishment of open and collaborative culture, as well as competencies for supporting cooperation and community building.

Living labs should be managed on the levels of community interaction, stakeholder engagement, and methodological setup to succeed in implementing living lab projects and to create user-centered innovations (Veeckman et al., 2013). Almirall and Wareham (2011) situate the role and applicability of Living Labs in the context of open innovation at micro level and in systems of innovation at macro level.

2.3 Living labs in Kenya

The long-term strategic plan of the Kenyan Government, Vision 2030 (Retrieved from https://vision2030.go.ke), recognizes the key importance of ICT and innovation. Sustainable Living Labs can be seen as a tool to enhance ICT research cooperation, local innovation, entrepreneurship and wider socio-economic and community development. In Kenya, e-Skills, Agriculture, Health and Public Service Delivery are key areas that would benefit from a Living Labs oriented approach (Cunningham et al., 2012). The recent explosion of local ICT development groups in Kenya has set the stage for innovation of applications and information services (Kenya National ICT Masterplan,2014/2017). Kenya has been home to multiple African Regional hubs including IBM's African Research Lab, Nokia's Africa Headquarters and Google's Sub-Saharan Africa. Kenya has implemented a number of innovative e-government services such as e-Citizen but the lack of stakeholder engagement in the project has severely affected their success (Ondego & Moturi, 2016).

Kenya has only 25 Living Labs. They include the following: the hub East Africa (Retrieved from https://theentrepreneurshub.com); StartUpAfrica (Retrieved from http://startupafrica.org/); Growthafrica (Retrieved from https://growthafrica.com); MEST Kenya (Retrieved from https://meltwater.org/tag/kenya/); NaiLab (Retrieved from https://nailab.co.ke); iHub (Retrieved from https://ihub.co.ke); LakeHub (Retrieved from http://lakehub.co.ke); m:lab East Africa (Retrieved from www.mlab.co.za/tag/kenya/); 88 mph (Retrieved from www.88mph.ac/nairobi/); Nairobi Startup Garage (Retrieved from https://nairobigarage.com); AfriLab (Retrieved from www.afrilabs.com); GearBox (Retrieved from www.gearbox.co.ke); Seas Technologies Innovation (Retrieved from www.sstgroup.com/innovation-labs); and C4DLab (Retrieved from http://c4dlab.ac.ke). The main activities carried out in these Living Labs can be summarized as support to start, grow and run a sustainable business. This is achieved through training, incubation, mentoring, connections to entrepreneurs, commercialization, strategic advice on business acceleration, business support services and venture funding.

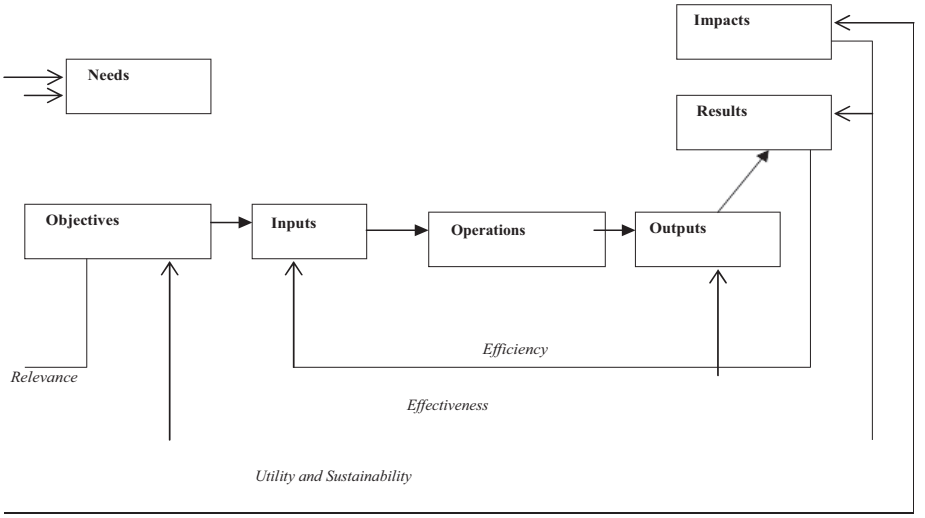
Kenya has recently experienced considerable technological entrepreneurial growth, facilitated by innovation regulatory environments, evolution of national research education networks and rollout of optic backbones. However, innovation spaces have sustainability challenges with their business models, limited funding and entrepreneurship support, as well as insufficient collaboration and coordination between stakeholders (Cunningham, Cunningham, & Ekenberg, 2014). Mendi and Mudida (2018) found that previous informal status negatively affects technological innovativeness and concluded that in Kenya there are serious informational disadvantages of firms that began informally and eventually transitioned to formality as opposed to firms that began in the formal sector. In their unpacking of European Living Labs, Dutilleul, Birrer, and Mensink (2010) identify three distinct social configurations contact, communication and collaboration. Living Labs must provide a mechanism for bringing innovation enthusiasts to interact to contribute to knowledge sharing. Living Labs require strong forms of collaboration between designers, technology specialists, researchers and entrepreneurs.

2.4 Sustainability assessment models

The research examined six models and theories. The Technological, Organizational and Environmental (TOE) model (Tornatzky, Fleischer, & Chakrabarti, 1990) explains that three different elements of a firm's context influence technological innovation. The DeLone and McLean IS success model (DeLone & McLean, 2003) focuses on measuring the benefits of success of IS system and consists of seven dimensions of success: System Quality, Information Quality, Service Quality, Intention to Use, Use, User Satisfaction, and Net Benefits. The Diffusion of Innovation model (Rogers & Shoemaker, 1971) focuses on the adoption of innovation and consists of five main characteristics: Relative Advantage, Compatibility, Complexity, Observability and Trialability. The Sustainable Livelihood model (Parkinson & Ramirez, 2006) discusses poverty related issues and how ICT can be used to solve these issues and has four focus areas, namely Vulnerability Context, Livelihood Assets, Policies and Processes, Livelihood Outcomes. The Living Lab Triangle Model (Veeckman et al., 2013) analyzes the link between characteristics of the living labs and their effects on the outcome and consists of three pillars, namely Innovation Outcome, Living Lab Environment, and Living Lab Approach. The four capital method of sustainable development evaluation (Ekins, Dresner, & Dahlström, 2008) consists of four capitals, namely, human, financial, environmental and manufactured.

2.5 Conceptual framework

The Four Capital Method of Sustainable Development Evaluation (Ekins et al., 2008), which places emphasis on sustainability development was adopted for this research. The model can be used to show a causal relationship of how sustainable development can be achieved. The success of a project is assessed and evaluated through the net benefits (results and impacts). The proposed model (Figure 1) depicts the relationship between the needs, objectives, inputs, operations and output, which are the independent variables.



Source: Ekins *et al*. (2008)

Figure 1.
Conceptual framework

These dimensions would then influence the results and impacts, which are the dependent variables.

Needs: This dimension assesses the products or services required by the end users. It focuses on the trends, technology, accessibility, quality and cost. The needs should be relevant to the objectives of the project. The needs of the end users will determine whether users will use the system, which in turn will affect the results.

Objectives: This dimension focuses on the aim of the lab. There are three different types of objectives: *Operational objectives*, expressed in terms of outputs (e.g. the provision of training courses to the long-term unemployed); *Specific objectives*, expressed in terms of results (e.g. the employability of the long-term unemployed); *Global objectives*, expressed in terms of impacts (e.g. a reduction of the unemployment rate among the previously long-term unemployed).

Inputs: This dimension examines the funding of the labs and sources of finances and the budget allocated by the host organization. This dimension is measured in terms of financial indicators that are used to monitor progress in terms of the (annual) commitment and payment of the funds available for operational costs. These indicators are readily available but give little information about the effectiveness of the lab (Ekins et al., 2008).

Operations: This dimension focuses on activities that are carried out in the living labs, the management of the labs, the staff who run the labs, the funding sources, users and infrastructure of the living labs. Operations is measured in terms of number of people in the lab, qualifications of the staff, number of funding organizations, resources supported by the funding organizations, the infrastructure of the labs and who supports it.

Output: This relates to the outcomes of the projects of the living labs. System output is measured in terms of accuracy, completeness, consistency, relevance, availability, understandability, usefulness and timeliness. This dimension has an effect on decisions made by the user and the quality of work.

Results: This is the direct and immediate effect of project results. This dimension provides information on changes related to, for example, the behavior, capacity or performance of direct beneficiaries. It is measured in terms of physical (number of innovators, number of successful and failed projects etc.) or financial (leverage of host resources, decrease in operational cost). Results can be measured in terms of time savings, awareness, individual productivity, effectiveness, task performance, usefulness, business process change, cost savings, enhancement of communication and collaboration, enhanced reputation, improved decision-making and quality improvement.

Impacts: This refers to the project's consequences beyond its immediate effects. Specific impacts are those effects occurring after some time but which can be directly linked to the action taken. Global impacts are longer-term and affect a wider population of living labs. The impacts that are of interest are those that either support, or are in conflict with, the achievement of other policy objectives. Impact can be measured in terms of physical (number of innovators, number of successful and failed projects etc.) or financial parameters (leverage of host resources, decrease in operational cost etc.). Other measures are time savings, awareness, individual productivity, effectiveness, task performance, usefulness, business process change, cost savings, enhancement of communication and collaboration, enhanced reputation, improved decision-making and quality improvement.

An evaluation of any Living Lab must address a number of issues (Ekins et al., 2008). *Relevance* – To what extent are the project objectives relevant in relation to the evolving needs and priorities of the users? *Efficiency* – How were the resources (inputs) turned into outputs or results? Efficiency analyses the ratio between the outputs, net benefits and the inputs (particularly financial resources) used to achieve them. *Effectiveness* – How far has

the project contributed to achieving its specific and global objectives? Effectiveness analysis compares what has been done with what was originally planned; that is, it compares the actual with the expected. *Utility* – Did the project have an impact on the target groups or populations in relation to their needs? *Sustainability* – To what extent can the changes (or benefits) be expected to last after the project has been completed?

3. Methodology

3.1 Research design

The research adopted a descriptive research design to obtain data from innovators, users and employees relating to the sustainability of Kenyan Living Labs regarding the development of products and services. A survey design was adopted. An appropriate conceptual framework for the assessment of sustainability of Living Labs was developed.

3.2 Target population and sample size

Mugenda and Mugenda (2003) describe the target population as generally a large collection of individuals or objects that are the focus of a scientific query. The target population in this study was all innovators, users and employees of the Living Labs in Kenya. These respondents are the majority users of Living Labs and are affected by their sustainability. A sample of 150 was drawn through random and purposive sampling. The former was used to select the innovators who use the lab, while the latter was used to select the staff that had the information related to the policies of the labs. A statistical formula suggested by (Mugenda & Mugenda, 2003) was used to determine the sample size. The formula is argued to be suitable in cases where the sample size in not known.

3.3 Data collection and analysis

Both online and hard copy questionnaires were used to target more respondents. One set of questions targeted employees (staff) while the other was for innovators and users. There were both closed and open-ended questions. Open-ended questions were used to provide respondents with an opportunity to give their independent points of view. Each question was designed to address the objectives and research questions under study (Mugenda & Mugenda, 2003). The questions revolved around the operations of the labs, strategies to ensure that the labs will be sustainable in the future, the management of the labs, funding options and the sustainability of the projects.

The questions covered the following aspects of the conceptual model: needs, objectives, inputs, operations and outputs, which have an impact on the results.

An interview guide, with a different set of questions meant to establish funding and support provided as well as challenges in addressing sustainability of the labs, was used to conduct interviews in person. Most of the data were collected through questionnaires.

The data collected were coded and organized into themes. The quantitative data were analyzed using SPSS. Descriptive statistics was used for quantitative data. The descriptive statistics are composed of measures of central tendency, association and dispersion. The descriptive data findings were presented using tables and graphs.

3.4 Validity and reliability

An interview guide and questionnaire were developed, and both were scrutinized by an experienced researcher before they could be administered. The test-retest method of assessing reliability was employed whereby the same instrument was administered twice to the same group.

A five-point Likert scale (1 = Strongly disagree 2 = Disagree 3 = Don't know 4 = Agree 5 = Strongly agree) was used because it increases the response rate and response quality along with reducing respondents' frustration level (Dawes, 2008). The raw data collected from the various respondents were categorized and coded. The data were organized systematically by grouping the responses in different categories and then analyzed using SPSS.

4. Results and discussion

4.1 Response rate

Out of the 150 respondents sampled (135 user and innovators; 15 staff), there were 107 valid responses (95 user and innovators; 12 staff) giving a response rate of 75 per cent, which was considered satisfactory.

4.2 Demographics

Table I shows a summary of the demographics of the respondents. The views expressed in this study were dominated by male users, innovators and employees. There was a high presence of young respondents, perhaps reflecting their high participation in the Living Labs. The majority of those who participated in this study had graduate degrees indicating some form of professional training. The majority of the innovators had been attached to the Livings Labs for only one year while most of the staff had worked at their centers for a period between 2 and 5 years.

4.3 Attributes of living labs in Kenya

Living Labs can be differentiated based on activities, structure, organization and coordination. Leminen, Westerlund, and Nyström (2012) proposed four types of Living Labs: utilizer-driven, enabler-driven, provider-driven and user-driven. This characterization will help in identifying which actor drives the innovation, to anticipate likely outcomes, and to decide what kind of role they should play. The following features were identified in the Living Labs in Kenya:

Feature	Classification	Users and innovators Frequency	(%)	Staff Frequency	(%)
Gender	Male	45	56.3	8	89.9
	Female	35	43.8	1	11.1
Age	20 and < 20 years				
	21-30 years	50	62.5	4	50
	31-40 years	30	37.5	4	50
	41-50 years				
	Over 50 years				
Education level	Primary				
	Secondary	5	6.3	2	22.2
	Diploma/Higher Diploma				
	Undergraduate	5	6.3		
	Graduate	45	56.3	6	66.7
	Other	25	31.3	1	11.1
Experience at the lab	1 year or less	40	72.7	2	22.2
	2-5 years	15	27.3	5	55.6
	>5 years			2	22.2

Table I.
Demographics

Source: Research Data, 2018

- *Establishment and location of the labs*: The labs are mostly located in the capital city Nairobi and were established between 2010 and 2015. They had varying experiences since their inception and different abilities to support innovators and users.
- *Lab capacity and type of innovators targeted by the labs*: Various labs had varying lab capacities. Human capacity ranged from 10 to 250 innovators and 6 to 15 employees. The labs targeted innovators in disciplines such as health, agriculture, governance, transport, finance and education.
- *Lab independence and funding*: The majority of the labs (71.2 per cent) were stand-alone while the rest are hosted by other organizations. Shareholding was different based on the type of ownership and the design. The labs that were hosted benefited from funding, human resource, infrastructure, office space among other operational resources. The type of the ownership determined the source of funding. Some of the labs were fully funded by their host organizations and offered opportunities for innovators for free while others offered the innovation spaces at a cost. This shows that some of the labs were established with a sole purpose of supporting innovation while others had a profit motive. Other sources of funding streams for the labs included aid from donors, private sponsors and partners, government, income generating projects, research, co-working, events, programs and consultancy and membership fees.

4.4 Dimensions of the four capital method of sustainable development

The results which test the dimensions of the four capital method of sustainable development are discussed below.

Needs of the users/innovators: The study shows that all staff members agreed that their Living Labs had strategic plans and the staff understood the need of innovators, users had knowledge and skills for running the labs. The majority of the users and innovators (73.4 per cent) agreed that the objectives of the labs were relevant to current needs of the users. A substantial proportion of the users (85.7 per cent) agreed that the needs of the labs were attainable and realistic. This shows that the needs of the labs were current, realistic and attainable by the users and innovators. Participation of users, and user needs prevent knowledge asymmetries (Dutilleul et al., 2010).

Objectives of the lab: The objectives of the lab were assessed to help in determining their sustainability. All the staff members agreed that they understood the objectives of the lab and that those objectives were relevant to the needs of the lab. They also agreed that the labs provided training/mentorship to their innovators. The majority of the users agreed that innovators understood the objectives of the lab (64.3 per cent), that the labs provided training and mentorship to innovators (85.7 per cent), and that the objectives of the labs were realistic and attainable (80 per cent). The results show that the objectives of the labs were well-known to both the staff and the users and that they were attainable and realistic.

Inputs into the operations of the lab: In terms of inputs, half of the staff members (50 per cent) did not know whether the successful innovators supported the upcoming innovators, unlike most of the users (56.3 per cent) who affirmed that successful innovators supported their upcoming counterparts. In terms of funding, 62.5 per cent of the staff members and 57.2 per cent of the users indicated that the labs received funding from funders. Further, 37.5 per cent of the staff members indicated that the funding was done in a timely manner while 35.3 per cent of staff members were indifferent on the timeliness of the funding. When the same information was sought from the users, 40 per cent affirmed that the labs received funding in a timely manner. Similarly, same proportion of users was indifferent on whether funding was done in a timely manner or not. In terms of fee amount charged by the labs, 62.5 per cent of the staff and 76.9 per cent of the lab

users affirmed that lab services in their labs were affordable. On support to the labs, 87.5 per cent of the staff members agreed that stakeholders supported their labs and 75 per cent confirmed having received support from their host organizations. The results show that in terms of inputs, the labs seem to have reliable inputs from successful innovators, funders, shareholders and host organizations to sustain future operations.

The fees paid were affordable and thus it could be afforded by most people in the future and this could not hinder the enrolment of more innovators into the labs.

Outputs of the lab: Information on the output of the labs was collected to ascertain the sustainability of the labs from the perspective of the outputs. According to most of the staff members (77.8 per cent), innovations from the labs met user requirements. However, only 43.8 per cent of the users indicated that the labs met their expectations. In this case, results from users were preferred. Thus, the innovations in the labs whose data were captured did not meet user requirements. Further government policies and regulations affected the output of the labs according to 55.5 per cent of staff members and 46.6 per cent of the users implying that the labs could not deliver properly due to the influence from the governments. Most of the staff members (66.6 per cent) and 46.7 per cent of the users affirmed that there was high success rate in their labs. A large proportion (77.8 per cent) of the staff members indicated that the lab outputs were aligned with current trends. In summary, the results show that conversion of inputs to outputs was very good. However, the final innovations did not meet requirements of most users and were highly influenced by government policies and regulations.

Operations of the lab: The majority of staff members (77.7 per cent) and users (46.7 per cent) indicated that labs were highly automated and technologically advanced. The majority of the staff (88.9 per cent) indicated products and services in the labs were evaluated at every phase of development. This compares with 53.3 per cent of users who did not know such evaluations occurred. According to 77.8 per cent of the staff members, test users interacted with the innovators in the labs while 50 per cent of the users could not confirm the same.

In terms of skills, staff members (88.9 per cent) indicated that the labs had highly skilled staff resources. However, the majority of the users (60 per cent) did not confirm that the staff were highly skilled. The study further shows that both staff (100 per cent) and lab users (80 per cent) agreed that the labs had good infrastructure. Further details from the staff members indicated that labs trained their staff on upcoming technological trends and provided good supervisions of the lab activities.

Results of the lab activities: 62.5 per cent of the staff and 46.6 per cent of the lab users indicated that the number of successful projects had increased and the number of innovators had increased. Most of the staff members (62.5 per cent) indicated that the number of failed projects had decreased. This proportion however was less under the category of the lab users with only 28.6 per cent of the same opinion and a half (50 per cent) being unable to tell whether the number of failed projects had decreased. The results show that there was consensus on the increase in the number of innovators but not on the issue of the increase in the number of successful projects between the staff and the users. The staff however indicated that they received awards for innovations of the labs.

Impacts of the lab activities: The usefulness of the labs was assessed through the end term results of the projects. According to most of the staff and lab users, the long-term effects of the labs were noticeable, which was an assurance of the future of the living labs.

Qualitative analysis: Qualitative data analysis seeks to make general statements on how categories or themes of data are related. Qualitative data were collected by interviewing some staff. The progress of the Living Labs is affected by various challenges. The most occurring challenges facing the living labs in Kenya are Funding (insufficient funding); Infrastructural (inadequate, slowness and poor maintenance); Technology (big gap between technology and education,

changing technology, slow internet connections); Design (poor communication, inefficiency, different criteria that do not use innovators profile, lack of programs for entrepreneurs); and Support (low government support, lack of awareness, outside interference from organizations).

To address the above-mentioned challenges, several measures had been put in place. They include flexible budgets; fundraising; seed fund; having funders who replace the equipment and redesign the lab; incorporating the most recent technology; introduction of other sustainable projects to run the operations; joint programs; policy activation; outreach programs; assisting startups to articulate their ideas; more focus on the entrepreneurial skills; providing additional expertise; hiring skilled and qualified personnel; proper advertising and marketing; and making strategic partnerships.

5. Conclusion

To address the issue of sustainability of Living Labs in Kenya, several measures must be taken to contain the likely deteriorating capability of their growth and future sustainability. The type of innovations and strategies put in place by the labs to ensure their sustainability significantly influences the sustainability of the labs. Living Labs are prepared to survive in the future. This is evident as some of the labs have strategic plans on how to pursue future environment, developed ways of choosing right people to incubate, identified the types of skills required, identified the variety of innovations and their location to ease accessibility.

However, the study revealed that the Living Labs do not have capacity to accommodate a large number of incubators at a time thus limiting the number of innovations which can be supported. It is desirable that the Living Labs expand their capacities to support more innovators. There is need to institutionalize the support of the host organization to the labs to ensure continued growth and expansion.

The study noted that the approach used by the Living Labs matters. Most of the labs regularly evaluated their innovations, products and services to ensure that they delivered as expected. Others have used highly skilled staff and created interactions between consumers and innovators. These approaches have been found to have a significant impact on the sustainability of the labs.

This research has demonstrated the applicability of the Four Capital Method of Sustainable Development Evaluation to assess sustainability of Living Labs in Kenya in terms of addressing user needs, objectives of the Living Labs, inputs and resources required by the labs and lab operations.

Considering the emphasis placed on innovation by all government policy documents in Kenya (Vision 2030 planning blueprint, ICT master plan, ICT policy) the sustainability of Living Labs has the potential to address Kenya's and Africa's socioeconomic and developmental needs. This paper has attempted to provide a deeper understanding of the sustainability of these Living Labs in light of the important role. The paper can also be used to explore a theoretical framework to the discussion about public policy to facilitate open innovation.

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