

The business models of tech hubs in Africa: implications for viability and sustainability

KOLADE, Seun <<http://orcid.org/0000-0002-1125-1900>>, ATIASE, Victor, MURITHI, William and MWILA, Natasha

Available from Sheffield Hallam University Research Archive (SHURA) at:

<https://shura.shu.ac.uk/31888/>

This document is the Accepted Version [AM]

Citation:

KOLADE, Seun, ATIASE, Victor, MURITHI, William and MWILA, Natasha (2021). The business models of tech hubs in Africa: implications for viability and sustainability. *Technology Analysis & Strategic Management*, 33 (10), 1213-1225. [Article]

Copyright and re-use policy

See <http://shura.shu.ac.uk/information.html>

The business models of tech hubs in Africa: implications for viability and sustainability

Oluwaseun Kolade ^a(corresponding author), Victor Atiase^a, William Murithi^a and Natasha Mwila^a

^a [Leicester Castle Business School](#)
[De Montfort University](#)
[Leicester, LE1 9BH, United Kingdom](#)
[Email: seun.kolade@dmu.ac.uk](mailto:seun.kolade@dmu.ac.uk)

1. Introduction

Since their emergence, a little over a decade ago, modern Do-It-Yourself (DIY) laboratories have grown increasingly popular across the world. They are characterised by low financial and professional barriers to entry, enabling “ordinary” individuals to invent, produce and sell goods and services through open, distributed, and minimal processes (Fox, 2013). DIY labs take on different forms, including garage biology, citizen science, community-based research, open science, open innovation, and tech hubs (You *et al.*, 2020). In this study, we focus on tech hubs. A tech hub is a co-working space where technologists, computer scientists, programmers and web developers come together to network and share knowledge and skills to actualise their ideas (Jiménez and Zheng, 2018). Like other forms of DIY labs, such as DIY biology, tech hubs provide communal spaces and digital facilities for knowledge sharing, co-production, ideation and experimentation with new ideas. Tech hubs operate on the principles of open innovation and inclusive participation, where any interested person can engage and benefit. They can also be programmatic dependent or independent labs focusing on improving peoples’ lives (social impact); or they can be incubators or accelerators focusing on bringing new products to market (Whitt, 2016). Across the world, high growth tech hubs are characterised by higher frequency of early start-ups entering the market, higher investment, and higher concentration of early state companies (CBInsights, 2018).

The last five years has witnessed a rapid expansion of tech hubs in Africa. One report indicated that, as of 2015, there were 117 tech hubs in Africa. The vast majority of these were owned or led by the private sector, with only nine led by academic institutions and 10 of them government-owned (Kelly and Firestone, 2016). Between 2016 and 2019, African countries witnessed a significant expansion of tech hubs, from 314 in 2016 to 442 in 2018 and 643 as of October 2019 (Giuliani *et al.*, 2019). In other words, African tech hubs have more than doubled within the last three years leading to 2019. However, during the same period, 110 hubs closed their operations “due to pivoting, bankruptcy, or the expiration of their mandate” (Giuliani *et al.*, 2019, p.5). While the rapid expansion of tech hubs in Africa has attracted considerable attention in recent years (see, for example, Atiase, Kolade & Liedong, 2020; Jiménez and Zheng, 2018; Kelly and Firestone, 2016), fewer studies, to the best of our knowledge, have examined burning questions regarding viability and sustainability (Ansong and Boateng, 2019). In this paper, we explore the suggestion

that the critical difference between African tech hubs that falter and fail, and those that survive and thrive, is not the level of technological innovations that drive new product development; but the non-technological business model innovations that underpin value capture.

Much of the conversations around the fourth industrial revolution have focused attention on how technological innovations and digital transformations have shaped the transition from the market economy to the knowledge economy. Indeed, technology increasingly pervades all of life, including the world of work, social relationships, and civic space. In more recent years, scholars and practitioners have sought to draw the distinction between technological innovations which are instrumental for the creation of new products and services; and the business model innovations required to link value creation with value capture (Baden-Fuller and Haefliger, 2013). Often, it is argued, a better business model will beat a better idea or technology (Chesbrough, 2007).

Business model has been defined as “a system that solves the problem of identifying who is (or are) the customer(s), engaging with their needs, delivering satisfaction, and monetizing the value” (Baden-Fuller and Haefliger, 2013, pp.1). A typical business model articulates the value proposition; identifies users in a market segment; defines the structure of the value chain; specifies the revenue generation mechanism; defines the position of the firm within the ecosystem; and formulates the firm’s competitive strategy (Chesbrough, 2007). This traditional conception of business model is limited in its focus on economic outcomes, in terms of financial revenue and monetary value. Thus, in this paper, we extend this definition by adopting Joyce and Paquin (2016)’s triple layered business model of economic, social and environmental value creation. This arguably provides a better framework to analyse the financial viability of tech hubs, as well as their social and environmental impacts.

This paper raises two related research questions about tech hubs in Africa: firstly, what are the common business models employed by African tech hubs to create economic, social and environmental value? Secondly, how do these business models mediate the link between technological innovations and hubs’ survival, viability and competitiveness? To address these, we employ the triple-layered business model of economic, environmental, and social value creation (Joyce and Paquin, 2016). This provides a more holistic and integrated view of how African tech hubs create value for stakeholders, and how they capture value for themselves. Accordingly, we select case studies of different types of hubs in terms of their history, formation, and focus- across East and West Africa. The rest of the paper is organised as follows. First, we review the literature to set out the theoretical underpinning of the paper, and critically interrogate the links between technological innovations, business models and value creation and capture . Next, we set out the case study methodology of the paper. This is followed by a presentation of findings and discussions. We conclude by setting out the practical and policy implications of the study and recommendations for future research.

2. Literature review

The tripled layer business model

A business model sets out the strategic logic of the firm to create and deliver value to its stakeholders and capture value for itself. Osterwalder and Pigneur (2010) proposed a business model canvas that comprises nine blocks covering four main areas of business: customers, offer, infrastructure, and financial viability. The nine blocks are: customer segments, value propositions, channels, customer relationships, revenue streams, key resources, key activities, key partnerships, and cost structure. Together, this business model canvas shows “the logic of how the company intends to make money” (Osterwalder and Pigneur, 2010, pp.15). In other words, this business model focuses on achievement of economic outcomes. While this model has significant analytical and practical merits, other scholars, and practitioners (Biloslavo, Bagnoli & Edgar, 2018; Sparverio, 2019) have highlighted its limited view of value creation and value capture. Organisations do not exist merely “to make money”, but also to deliver and capture non-economic values. While financial viability will always be an important indicator of business survival and sustainability, profit maximisation is not a necessary requirement.

To address the limitations inherent in Osterwalder and Pigneur’s business model, Joyce and Paquin (2016) proposed the triple layered model of organisational value creation. This model draws ideas from the Triple Bottom Line theory (Elkington, 1998), which proposes a new approach to evaluate the performance of organisations with respect to their economic, social and environmental outcomes. The economic bottom line focuses on measurement and evaluation of economic capital, defined as the total value of assets minus liabilities. These assets comprise physical capital (equipment and machinery), financial capital and, more recently, human capital. While the economic bottom line focuses on economic capital, the environmental bottom line addresses issues and metrics relating to natural capital. Thus, this component focuses on how organisations use renewable and non-renewable resources in their operations, and the wider impact of their activities on the ecosystem. Finally, the social bottom line focuses on the impact of organisations of social capital, a concept which comprises ideas of trust, solidarity, and collective action. The triple bottom line is sometimes described as the 3Ps (people, planet, and profit) and blended value (Hammer and Pivo, 2017)

Based on the foregoing, Joyce and Paquin proposed an extension to the original (economic) business model by adding environmental life cycle layer and social layer. Together, they argued, the three layers provide a more integrated and holistic view of organisational value creation and value capture. The environmental layer is based on the lifecycle perspective. As the economic business model canvas seeks to increase revenue while reducing costs, the environmental business model canvas aims to maximise environmental benefits while reducing adverse environmental impacts. Thus, the environmental life cycle layer consists of the following nine blocks: functional value, production, supplies and outsourcing, materials, end of life, distribution, use phase,

environmental impacts, and environmental benefits (García-Muiña et al., 2020). The functional value is the quantitative description of the outputs of the organisational product or service being examined. It is the baseline for environmental life cycle impact assessment. The rest of the blocks are described in table 1.

The social layer in the triple layered business model canvas is based on the stakeholder approach. Stakeholders are defined as groups or individuals that influenced or are influenced by the actions and activities of an organisation. These include customers, shareholders, communities, governments, and suppliers, among others. The social layer comprises the following nine blocks: social value, employee, governance, communities, social culture, scale of outreach, end-users, social impacts, and social benefits (Joyce and Paquin, 2016; You et al., 2020). The social layer aims to analyse the influence on, and by, stakeholders, to create social impact. The items on the blocks are defined in table 1.

Table 1. The building blocks of the triple-layered business model canvas

Blocks	Economic business model canvas	Environmental business model layer	Social business model layer
1	<i>Customer segments:</i> The groups of people or organisations an enterprise aim to serve. e.g., mass, niche, segmented & diversified markets.	<i>Functional value:</i> The focal outputs of the product or service by the organisation under examination.	<i>Social value:</i> the aspects of an organisation's mission which focuses on creating benefits for its stakeholders and to the wider society.
2	<i>Value propositions:</i> The bundle of products and services that create value for the customer segments, and on account of which customers choose one company over the other.	<i>Materials:</i> the bio-physical stocks required to render functional value, e.g., physical materials for manufacturers and building and ICT infrastructure for service organisations.	<i>Employees:</i> information and indicators relating to the role of employees as core group of organisational stakeholders, e.g., types of employees and key demographic variables.
3	<i>Channels:</i> The means through which an enterprise reaches the customer segments to deliver value propositions.	<i>Production:</i> the transformation of raw materials to higher value products; or the process of running IT and logistics infrastructures to deliver services.	<i>Governance:</i> the organisational structure and the decision-making policies of an organisation.
4	<i>Customer relationships:</i> The type of relationship a company seeks to have with its customers, based on	<i>Supplies and outsourcing:</i> all other material and production activities	<i>Communities:</i> social relationships built with suppliers and local communities.

	customer acquisition, retention, or up-selling motivations.	necessary for functional value but not "core" to the organisation.	
5	<i>Revenue streams:</i> The cash that a company generates from its customer segments, either as transaction or recurring revenues.	<i>Distribution:</i> the physical means by which an organisation ensures access to its functional value.	<i>Societal culture:</i> the potential impact of an organisation on society as a whole, critical for creation of sustainable value.
6	<i>Key resources:</i> the most important assets required to make a business work. They can be physical, financial, intellectual, and human resources.	<i>Use phase:</i> the impact of clients partaking in an organisational functional value, e.g., repair and maintenance activities, energy requirements, etc.	<i>Scale of outreach:</i> the depth and breadth of the relationships an organisation builds with its stakeholders through its actions over time.
7	<i>Key activities:</i> the most important actions a company must perform to operate successfully. Categorised into production, problem solving and platform/networking activities.	<i>End-of-life:</i> activities and issues related to the point at which clients choose to end the consumption of the organisation's functional value. e.g., recycling, disassembly, incineration, or disposal.	<i>End users:</i> how the value proposition contributes to the quality of life of the end user who "consume" the value proposition.
8	<i>Key partnerships:</i> the network of suppliers and partners that make the business model work. They can be strategic partnerships of non-competitors, coopetition, joint ventures, or buyer-supplier relationships.	<i>Environmental impacts:</i> the ecological costs of an organisation's action, measured in terms of metrics such as CO2 emissions, human health, ecosystem impact and natural resource depletions.	<i>Social impacts:</i> the social costs of an organisation, which can be measured in terms of working hours, cultural heritage, health and safety, respect for intellectual property rights.
9	<i>Cost structure:</i> The most important costs incurred while operating a business model. Key characteristics are fixed costs, variable costs, economies of scale, and economies of scope.	<i>Environmental benefits:</i> the ecological value an organisation creates through environmental impact reductions and positive regenerative ecological actions.	<i>Social benefits:</i> positive social value created because of an organisation's action.

Technological innovations, business models and sustainability

Prior studies have explored the link between technological innovations, business models and performance (e.g., Baden-Fuller and Haefliger, 2013; Boons, Montalvo, Quist, and Wagner, 2013; Hu, 2014). However, most studies on the effects of business models on performance do not make clear distinctions between the effects of business model innovation, and technological innovations (Baden-Fuller and Haefliger, 2013) on performance. Furthermore, as noted in the foregoing,

performance is often viewed from a limited view of economic outcomes such as profit and sales. The literature recognises that new technological developments can facilitate, or sometimes necessitate, new business models (Hamelink and Opdenakker, 2019). It is however not clear if, and to what extent, business model innovations uniquely complement technological innovations in analyses of firm and organisational performance. This is especially relevant in the context of tech hubs who are, by default, defined more by their technological capabilities than their business acumen. The context of African tech hubs is an opportunity to explore the claim that business innovations make as much a difference as technological innovations in understanding the viability and sustainability of tech hubs and organisations (Hu, 2014).

In tandem with the triple-layered business model employed in this study, sustainability is conceived in terms of the three dimensions outlined in the literature: environmental sustainability, social sustainability, and economic sustainability. Environmental sustainability focuses on efficient use of resources while simultaneously enhancing ecological activities and productivity; social sustainability refers to the enhancement of social capital through opportunities created for community participation and benefits; and economic sustainability refers to the maintenance of capital through the appropriation of renewable and non-renewable resources for monetary outcomes (Saunila et al., 2019). Both technological and non-technological innovations play important roles in the sustainability engagement of organisations. Many scholars and practitioners have touted the importance and growing impacts of technological innovations for the global agenda for sustainability. Technological innovations have been instrumental to progress in renewable energy (Rantala et al., 2018). They have also played key roles in the drive towards the circular economy through the development of new product design and manufacturing processes that enable future re-use and re-manufacturing (Wang et al., 2021). They are also critical for organisation's market outcomes through the creation of new products or new features for existing products (Boons et al., 2013).

While they are certainly important, technological innovations in and of themselves are not sufficient for organisations to achieve environmental, economic and social sustainability. Business model innovations play a key role. In an age in which technology is ubiquitous, organisations distinguish often themselves, not through the discovery or creation of new products, but new ways they use to create and capture value from existing products and services (Rantala et al., 2018). Business model innovations encompass the environmental, social and economic dimensions outlined in table 1. The implementation of an organisation's innovative ideas can be captured and analysed through each of nine blocks described for economic, social and environmental business model. The aggregate of activities across the three categories provide an integrated view of sustainable business model, defined by Lüdeke- Freund (2010, pp.23) as a "business model that creates competitive advantage through superior customer value and contributes to a sustainable development of the company and society".

Amid the positive stories of growth highlighted in the introduction, the examples of African tech hubs that have failed or shut down may be connected more with failure to establish and operationalise sustainable business models, rather than a deficit of technological competence as such. In order to achieve better performance of technological innovations, tech hubs may need to combine otherwise conflicting themes in their business model design. Such ambidexterity approach provides an effective solution to managing conflicting activities in the implementation of business model innovations, for example with regard to efficiency and novelty themes (Hu and Chen, 2016). That is, hubs need to pay close attention to efficient utilisation human, material and financial resources, while also harnessing opportunities to create and deliver new products and services. They also need to focus more attention on appropriate strategy for scaling- how and when they mobilise and deploy resources to expand their products and services range and their customer reach.

3. Methodology

Following several previous research on tech hubs in Africa such as Atiase et al. (2020), Giuliani, D. et al. (2019) and Kelly et al. (2016), a case study research design was adopted in this study. We specifically investigated the triple-layered model of organisational value creation in the context of tech hubs in Africa. The multiple case study design enabled us to explore the differences and similarities across and within the selected cases due to the existence of the wide differences in political, cultural, and institutional dimensions of tech hubs in Africa (Baxter & Jack, 2008). Thus, we selected cases from two major regions of Africa namely West Africa (Nigeria) and East Africa (Kenya) in understanding the broad landscape and operational activities of tech hubs in the continent. Both Nigeria and Kenya are important economies in terms of technology development and entrepreneurship. Both countries are reputed to be the epicentres of technology entrepreneurship on the continent. For the Nigerian case, we selected Winnovation Hub, one of the oldest tech hubs with strong presence in key Nigerian cities such as Lagos, Abuja and Ibadan. For the Kenyan study, we chose iHub, one of the largest and thriving tech hubs in East Africa located in Kenya's capital, Nairobi.

In line with Yin (2003), our methods of data collection include documentation from innovation websites, archival records and interviews of key informants. This enables us to fill the gaps in the information available from one source, and to compare and triangulate the information obtained for each case, and across the cases. Subsequently, we adopted a thematic analysis approach along with three main thematic categories: economic business model, social business model, and environmental business model which is in line with our adopted tripled layered model. With these, we offer insights and reflections on how, or if, the tech hubs are creating and capturing economic, social, and environmental values in their business models. Regarding data analysis, thematic analysis was adopted. Thematic analysis was adopted because it allows flexibility in engaging the theoretical assumptions underpinning the study (Javadi & Zarea, 2016). Secondly, from a constructionist methodological position, the thematic analysis enabled us to analyse and present

the meanings from the data in relation to the Triple-layered model as it applies to the hubs across the selected regions of Africa (Joffe & Yardley, 2004).

4. Findings

4.1 Wennovation, Nigeria Background

Wennovation was founded in Lagos, Nigeria, in 2010 as an innovation development arm of LoftyInc Allied Partners. It was launched as a local initiative to support enterprise development across many sectors including Agriculture, Education, Health Care, Clean Energy and Social Infrastructure. Thus, in its mission and vision statements, Wennovation sets out an agenda to “inspire and empower African entrepreneurs to solve immediate socio-economic challenges by leveraging entrepreneurs to solve immediate socio-economic challenges by leveraging technology, resources and network collaboratively” (Wennovation Hub, 2020c, pp. 5) Since its inception, Wennovation has trained more than 10,000 youths, incubated more than 300 start-ups, and facilitated the creation of more than 1,000 jobs through the start-ups. The start-ups are reported to have raised more than \$2.6million till date (Wennovation Hub, 2020b). Since its launch in Lagos in 2010, Wennovation has expanded and launched operations in other key Nigerian cities such as Ibadan, Abuja, and Kaduna (Wennovation Hub, 2020a).

4.2 iHub, Kenya Background

Innovation Hub (abbrev. iHub) started as an idea in 2008, during the Barcamp Nairobi that focused on creating the first static space for the burgeoning tech community in Nairobi, Kenya. In 2009, the much-hyped submarine fibre optic cable touched the shores of Mombasa beaches, about 500 kilometres from Nairobi, provided the much-needed boost to the idea of creating a tech community hub. Since they officially opened their doors in 2010, iHub has been at the forefront in supporting tech start-ups and community development. iHub’s mission is built around three thematic areas of community, entrepreneurship, and research. Thus, its activities focus on building “an eclectic community of developers, supporting start-ups through incubation and accelerator programmes, and engaging in research to find create new knowledge about new uses and approaches to technology, especially in the African context. Recently, iHub was acquired by Nigeria’s CcHub at an undisclosed amount (iHub 2020b; Techish Kenya, 2019).

4.3 Findings

Table 4.3.1 Economic Business Models

Business model segment	Wennovation	iHub
Customer Segment	Enterprise developers in agriculture, education, health care, clean energy, and social infrastructure	Technology entrepreneurs, NGOs and public sector organisations.
Value Proposition	Connect start-ups with critical human capital that would be instrumental to the promotion of their innovation. Provide hub members with access to facilities, services, and events, including office spaces and training programmes. Offer opportunities for nascent entrepreneurs to expand their networks and connect with/join larger companies. Provide accelerator services for existing entrepreneurs willing to scale up, and research and consultancy services for NGOs, multinationals and other stakeholders.	Create an ecosystem for innovation and technology to solve pressing issues in which those innovations spur entrepreneurial ventures that create jobs and promote human capital development and opportunity”. Catalyse the growth of the Kenyan entrepreneurial ecosystem by providing strategic services for companies with high growth prospects- helping them to scale regionally and globally.
Channels	Awareness and publicity drives on their website, and through a range of regular and one-off events and activities undertaken across the country.	Communal space- both physical and virtual- where members can interact and create innovative solutions through new start-ups or existing businesses, research and consultancy services.
Customer Relationships	An explicit strategy for customer relationships is not articulated. Past and current activities indicate that they are oriented mainly towards an acquisition strategy of new users and customers with the expansion of operations across the country. There is no clear retention or up-selling agenda.	Attracted a wide range of large corporates, SMEs and individual tech enthusiasts in Kenya, Africa, and the globe at large. Partnered with the Kenyan government to deliver some sessions/Events focused on digital and youth employment. There is no articulated clear strategy in terms of customer acquisition, retention, or up-selling motivations.
Revenue Streams	Renting private offices, general coworking space for individuals and start-ups, and renting of board rooms and halls for events. Funding from partners to organise entrepreneurship and incubation programmes.	Four-tier membership structure through which it generates a significant proportion of its revenue through membership fees; events and consultancy/research activities; Government grants and patronage.
Key Resources	Physical premises used for the incubation, acceleration and training programmes, the human capital of software developers and training facilitators, and investors.	Physical space and strategic location at the heart of Nairobi, and near the proposed Silicon Savannah Technology City, the portfolio of human resources they have built and attract.
Key Activities	Incubation and accelerator programmes, training and consultancy, workshops, and competitions.	Incubation and accelerator programmes, training and consultancy, workshops.
Key Partnerships	Local and international NGOs such as Bill & Melinda Gates; local and international universities such as Emory University in the US, University of Ibadan, and Bowen University in Nigeria; government partners such as the Nigerian Federal Government; and industry partners such as Networks of Incubators and Innovators in Nigeria (NIINE)	Major international players in the tech sector such as Google, Microsoft, Nokia, Wananchi, and MIH, local partners in the public and private sectors including schools and tech enterprises.
Cost Structure	Salary costs, ownership/renting and maintenance costs for its premises, and utility costs	Salary costs, ownership/renting and maintenance costs for its premises, and utility costs

4.3.2 Social Business Model

Business model innovations	Wennovation	iHub
Social value	Social value sectors: Agriculture, Healthcare, Education, Clean Energy and Infrastructure. Stated mission is to “inspire and empower African entrepreneurs to solve immediate socio-economic challenges by leveraging entrepreneurs to solve immediate socio-economic challenges by leveraging technology, resources and network collaboratively” (Wennovation Hub, 2020c, pp. 5).	Promotion of female entrepreneurship. For example, it established the ‘iHub Women in Business Programme’ to grow the number of socially and economically empowered women entrepreneurs who run women-owned/women-led sustainable businesses working in the ICT sector in Kenya (iHub 2019). They have also partnered with Akirachixs, an organisation which is focused on being the ‘leading source of African Female technology talent for the world’. In addition, they offer free membership to youth and other university students who cannot afford to pay the membership fees.
Employees	Software developers, business strategists, programme, and partnerships managers, among others.	Software developers, designers, and systems analysts, among others—typically in the youth demographics, short-term contractors, consultants and facilitators for project and event-specific tasks
Governance	Hierarchically managed by a governance team, national working team and community engagement team. The governance team is a four-member founding team comprising the executive director, programme director, lead strategist, and International Business Lead. The national working team includes a national programme manager and ecosystem and partnership manager. The community engagement team includes hub managers in each of their campuses.	Semi-hierarchical structure with a top-tier leadership team of managing and executive directors responsible for day-to-day running of the organisation. The mid and lower levels structures appear to be a little flatter, with employees exercising greater degree of autonomy and independence in decision-making in terms of creating and implementing innovative ideas.
Communities	Relationships with higher educational institutions in their locations, local governments, NGOs, schools, among others. There is however no clear evidence of active engagement with traditional community leaders.	Relationships with large technology organisations, government departments and agencies, and other local organisations. Also, iHub participates in organising events that are community focused with some focusing on alleviating poverty and other social problems in Kibera.
Societal Culture	Promoting technology uptake within the general population and bridging critical skills gap in the technology entrepreneurship landscape	Started as a social movement and made the country, region and world realize how to run a tech hub and how important these spaces are for development of technology. Captured popular imagination and promoted positive attitude to technology in Kenya and across the East African region. Harnesses convening power to support entrepreneurs and grow Kenya’ tech ecosystem.

Scale of Outreach	<p>From its starting point in Lagos, Southwest Nigeria, Wennovation has expanded to other regions in the country, including the Northwest and the nation's capital in Abuja. Reportedly trained more than 10,000 youths, supported 300+ start-ups who have gone on to create more than 1,000 jobs. Expanded its networking portfolio to the highest levels of the Nigerian government, as well as a growing network of international NGOs and academic institutions (Wennovation Hub, 2020c pp.3). Appears to have limited reach to international industry partners and markets.</p>	<p>Supported the establishment and growth of other local hubs in the country such as the Lake Hub (Kisumu, Western region), SwahiliHub (Mombasa, Coast region), and DeHub (Dedan Kimathi University, Central region). Also expanded activities internationally.</p>
End Users	<p>Unemployed or under-employed youth who have, through the hub's activities, launched thriving new ventures or got employment opportunities through the start-ups affiliated with the hub.</p>	<p>Venture creation opportunities provided for start-ups, and through the direct and in-direct job creation activities of its members, associates, and affiliates.</p>
Social Impact	<p>Limited information on the social costs of Wennovation's organisational policy and practice in terms of working hours, cultural heritage, health and safety, respect for intellectual property rights, etc. However, there is a pressing and ongoing health and safety issue as Nigeria's tech entrepreneurs, including Wennovation's hub members, have been a target of police harassment, extortion, and brutality (Wennovation Hub, 2019).</p>	<p>Significant number of workers at iHub are reported to be contractors who work on a short-term basis. There is a risk these could be trapped in the "gig economy" with fading prospects of realising their long-term entrepreneurial dreams.</p>
Social Benefits	<p>Contributions to human capital development within the technology entrepreneurial landscape. Highlighting collaboration, innovation, job creation, and social entrepreneurship. By focusing on key "social impact" areas (earlier mentioned), it has been able to drive significant social benefits for the wider population for example by enhancing food security and nutrition, improved access to health care, and expanding access to good quality education.</p>	<p>Economic and social empowerment of women entrepreneurs. Significant contributions to human capital development through skill development interventions, for example through the 'Craftsmanship training series' aimed at sharpening the skills of local developers (Wangari, 2014). Supported the development and deployment of technology as tools for humanitarian relief, local government, and election observation communities. For example, Ushahidi- an organisation closely linked with iHub was instrumental during the Kenyan post-election violence 2007-8 for tracing victims of violence and during the Haiti earthquake in 2010 in tracing survivors.</p>

4.3.3 Environmental Business Model

Wennovation	iHub
<p>No explicit environmental business model that outlines its strategies and activities in each of the nine blocks in the proposed environmental business model canvas. However, it has engaged in some activities and efforts aimed at promoting sustainable and environment-friendly practices. For example, in 2017, it partnered with the Global Alliance for Clean Cookstoves to organise a workshop for clean cookstove enterprises in Nigeria. The alliance is described as “a public-private partnership hosted by the United Nations Foundation to save lives, improve livelihoods, empower women, and protect the environment by creating a thriving global market for clean and efficient household cooking solutions” (Tech City, 2017, pp.1). Also, through its portfolio of successful start-ups, contributed to the promotion of technological interventions for smart logistics, online shopping, efficient use of materials and other sustainable practices across a whole spectrum of industry sectors (Wennovation Hub, 2020a,b,c)</p>	<p>No articulated specific environmental strategy in its own direct operations. Much of its activities, however, are implicitly driven by the overarching idea to promote the use of digital and innovative technology for efficient resource utilisation for product development and service delivery. Actively engaged in collaborative research with government and other industry partners on a wide range of environmental issues. For example, iHub authored a 2013 research report addressing information gaps that exist between citizens and water stakeholders (Salim et al., 2013). The report was funded by two international partners: Swedish Program for ICTs in Developing Regions (SPIDER) and Ford Foundation.</p>

5. Discussion and conclusion

The findings, by and large, underlines the importance of business model innovations for the success and viability of tech hubs in Africa. While there is a lot of progress on technology development and context-sensitive innovations, there appears to be relatively little attention on the development and implementation of innovative business models to capture value for the hubs, both at the domestic and international market. Across the two case studies it can be seen that the customer segments are modest and under-developed. For example, Wenvovation aims, primarily, “to serve enterprise developers in agriculture, education, health care, clean energy and social infrastructure”. iHub’s customer segment is more ambitious: in addition to technology entrepreneurs, they also have modest outreach to “NGOs and public sector organisations like schools and universities”. Given the ubiquitous nature of technology in this age of digital transformation, the hubs should be exploring opportunities to reach a wider spectrum of customers and users, and also deploy strategies to promote technology use among wider sections of the African populations, thereby creating new customer segments.

The focus of the hubs on high tech entrepreneurship is justified and necessary, as African entrepreneurs need be equipped and ready to respond to fast-paced changes and opportunities in the highly competitive global economic landscape. However, for African entrepreneurs and tech hubs, the ambitious drive for high tech entrepreneurship needs to be complemented with a strategic attention on middle-of-the-range technological solutions that are better suited and more accessible to majority of the African populations. This is where the hubs need to think more strategically beyond technological capabilities to new, appropriate business innovation that can create new markets by making technological more accessible to the middle class and lower income groups. This is line with the observations of Chesbrough (2007) and Hu (2014) on the importance of business model innovations for technology entrepreneurs. Such innovative business models will also be more responsive to specific local needs, challenges and peculiarities in ways that western and foreign products and services are less suited and less accessible.

The hubs also need to develop new business models to explore and develop new revenue streams. This is important because the revenue streams of the hubs do not appear to match the opportunities associated with the technological capabilities. While iHub generates its income mainly from its four-tier membership scheme and government grants, Wenvovation draws income mainly “from renting private offices, general coworking space for individuals and start-ups, and renting of board rooms and halls for events”, as well as income from collaborative events and workshops. The hubs should explore new income streams by developing innovative strategies oriented towards new customer acquisition and cost leadership, among others. These appear to be generally better suited to a developing market environment where technologies are rapidly diffusing among the population to more remote areas and previously under-served communities. In other words, in addition to satisfying the revenue strategy in their economic business model, these market strategies present the hubs with big opportunities to achieve ambitious outcomes in their social and environmental business model by making technologies accessible in remote areas, promote inclusive growth, and support sustainable, environment-friendly development outcomes. In the initial stages of adopting models that are more focused on promotion of innovations, the hubs’ outcomes are likely to be skewed in favour of social and environmental impacts, more than economic outcomes.

Another key area in need of strategic attention is the internationalisation strategy of the hubs. The two case studies indicate that most of the international activities of the hubs are linked with international donor organisations. There is a need for an aggressive drive to compete at the global stage, in terms of new product development and service provisions to get substantial shares of the global market. This will likely require a different combination of costs and

differentiation strategies from those employed for the domestic market. However, both the domestic and internationalisation strategies also need to be integrated and mutually reinforcing. Hubs need to invest in more efficient use of their resources to create and value at home, using lean and innovative approaches to mobilise human capital and create cheaper products and services at lower cost. Conversely, revenue generated from international market activities can be critical for promoting inclusive technology diffusion and market development in African countries. The tech hubs also need to co-opt the diaspora population as critical market links between African countries and the more advanced economies in say America and Europe.

Finally, the study has shown that African tech hubs need to be more deliberate and explicit in developing their environmental business models. Given the developing state of technological and industrial growth in the continent, African tech hubs have unique opportunities to shape the future of the continent in terms of efficient resource utilisation, green growth, renewable energy, smart cities, and the circular economy, among others. Indeed, because African countries are not- or less- locked in older, inefficient technologies, tech hubs can spearhead the drive for technological leadership and leapfrogging in greener, sustainable technologies. The triple-layered model of economic, social, and environmental business model need not be a zero-sum game. It can be a win-win mutually reinforcing model in which the environmental and social value creation enable tech hubs and their members to capture more and better economic value through the development and deployment of advanced technological capabilities and innovative business models.

References

- Ansong, E. and Boateng, R. (2019) 'Surviving in the digital era – business models of digital enterprises in a developing economy', *Digital Policy, Regulation and Governance*, 21(2), pp. 164–178. doi: 10.1108/DPRG-08-2018-0046.
- Atiase, V.Y., Kolade, O., Liedong, T.A., 2020. The emergence and strategy of tech hubs in Africa: Implications for knowledge production and value creation. *Technol. Forecast. Soc. Change* 161, 120307.
<https://doi.org/10.1016/j.techfore.2020.120307>
- Baden-Fuller, C. and Haefliger, S. (2013) 'Business Models and Technological Innovation', *Long Range Planning*, 46(6), pp. 419–426. doi: 10.1016/j.lrp.2013.08.023.
- Baxter, P., and Jack, S. (2008) 'Qualitative case study methodology: Study design and implementation for novice researchers', *The Qualitative Report*, 13(4), pp. 544-559.
- Biloslavo, R., Bagnoli, C. and Edgar, D. (2018) 'An eco-critical perspective on business models: The value triangle as an approach to closing the sustainability gap', *Journal of Cleaner Production*, 174, pp. 746-762. doi: 10.1016/j.jclepro.2017.10.281
- Boons, F., Montalvo, C., Quist, J., & Wagner, M. (2013) 'Sustainable innovation, business models and economic performance: an overview', *Journal of Cleaner Production*, 45, 1-8.
- CBinsights (2018) *Global Tech Hubs Report*, *CB Insights*. Available at:
<https://www.cbinsights.com/research/report/global-tech->

- hubs/?utm_source=CB+Insights+Newsletter&utm_campaign=f96f0dc2c5-Top_Research_Briefs_07_07_2018&utm_medium=email&utm_term=0_9dc0513989-f96f0dc2c5-88096205.
- Chesbrough, H. (2007) 'Business model innovation: It's not just about technology anymore', *Strategy and Leadership*, 35(6), pp. 12–17. doi: 10.1108/10878570710833714.
- Elkington, J. (1998) Partnerships from cannibals with forks: The triple bottom line of 21st-century business. *Environmental Quality Management*, 8(1), pp. 37-51.
- Fox, S. (2013) 'Paradigm shift: Do-it-yourself (DIY) invention and production of physical goods for use or sale', *Journal of Manufacturing Technology Management*, 24(2), pp. 218–234. doi: 10.1108/17410381311292313.
- García-Muiña, F. E., Medina-Salgado, M. S., Ferrari, A. M., & Cucchi, M. (2020). Sustainability transition in industry 4.0 and smart manufacturing with the triple-layered business model canvas. *Sustainability*, 12(6), 2364.
- Giuliani, D. *et al.* (2019) *Building a Conducive Setting for Innovators to Thrive a Qualitative and Quantitative Study of a Hundred Hubs Across Africa Briter Bridges*.
- Hammer, J. and Pivo, G. (2017) 'The Triple Bottom Line and Sustainable Economic Development Theory and Practice', *Economic Development Quarterly*, 31(1), pp. 25–36. doi: 10.1177/0891242416674808.
- Hamelink, M., & Opdenakker, R. (2019) 'How business model innovation affects firm performance in the energy storage market', *Renewable Energy*, 131, pp. 120-127.
- Hu, B. (2014)' Linking business models with technological innovation performance through organizational learning', *European Management Journal*, 32(4), pp. 587-595.
- Hu, B., Chen, W., 2016. Business model ambidexterity and technological innovation performance: evidence from China. *Technol. Anal. Strateg. Manag.* 28, 583–600. <https://doi.org/10.1080/09537325.2015.1122186>
- iHub, 2019a. Benin Startups spend learning weeks in CcHub and iHub [WWW Document]. Blogs. URL <https://ihub.co.ke/blogs/34502/benin-startups-spend-learning-weeks-in-cchub-and-ihub>
- iHub, 2019b. iHub Women In Business Program [WWW Document]. Programmes. URL <https://vc4a.com/ihub/ihub-women-in-business-program/>
- iHub, 2020a. Virtual STEM Hub - a COVID-19 Intervention [WWW Document]. iHub Educ. URL <https://ihub.co.ke/blogs/34713/virtual-stem-hub-a-covid-19-intervention>
- iHub, 2020b. CcHUB Announces Acquisition of Leading Kenyan EdTech Company - eLimu [WWW Document]. Blogs.
- Jiménez, A. and Zheng, Y. (2018) 'Tech hubs, innovation and development', *Information Technology for Development*. Taylor & Francis, 24(1), pp. 95–118. doi: 10.1080/02681102.2017.133528
- Javadi, M., & Zarea, K. (2016). Understanding Thematic Analysis and its Pitfal. *Journal of Client Care*, 1(1), pp. 34-40. doi:10.15412/J.JCC.02010107

Joffe, H., & Yardley, L. (2004). Content and thematic analysis. Research methods for clinical and health psychology, Carlifonia, Sage publihsers

Johnson, M. W., Christensen, C. M., & Kagermann, H. (2008) 'Reinventing your business model', *Harvard Business Review*, 86(12), pp. 57-68.

Joyce, A. and Paquin, R. L. (2016) 'The triple layered business model canvas: A tool to design more sustainable business models', *Journal of Cleaner Production*. Elsevier Ltd, 135, pp. 1474–1486. doi: 10.1016/j.jclepro.2016.06.067.

Kelly, T. and Firestone, R. (2016) *How Tech Hubs are helping to Drive Economic Growth in Africa, World Development Report 2016 Digital Dividends*. Available at: <https://openknowledge.worldbank.org/handle/10986/23645%0Ahttps://openknowledge.worldbank.org/bitstream/handle/10986/23645/WDR16-BP-How-Tech-Hubs-are-helping-to-Drive-Economic-Growth-in-Africa-Kelly-Firestone.pdf?sequence=1&isAllowed=y>.

Lüdeke- Freund, F. (2010) 'Towards a Conceptual Framework of Business Models for Sustainability', Knowledge Collaboration & Learning for Sustainable Innovation ERSCP-EMSU conference, Delft, The Netherlands, 49(0), pp. 1–28.

Osterwalder, A., & Pigneur, Y. (2010) *Business model generation: a handbook for visionaries, game changers, and challengers*. John Wiley & Sons.

Rantala, T. et al. (2018) 'The effect of sustainability in the adoption of technological, service, and business model innovations', *Journal of Cleaner Production*, 172, pp. 46–55. doi: 10.1016/j.jclepro.2017.10.009.

Salim, A., Orwa, A.O., Moraa, H., 2013. Role of technology in promoting transparency with Local Stakeholders in the Water Governance Sector. Nairobi. URL https://files.ihub.co.ke/ihubresearch/jb_WaterStakeholdersReportWEBpdf2013-8-29-07-43-17.pdf

Saunila, M. et al. (2019) 'Why invest in green technologies? Sustainability engagement among small businesses', *Technology Analysis and Strategic Management*, 31(6), pp. 653–666. doi: 10.1080/09537325.2018.1542671.

Sparviero, S. (2019) 'The case for a socially oriented business model canvas: the social enterprise model canvas', *Journal of Social Entrepreneurship*, 10(2), pp. 232-251. doi: 10.1080/19420676.2018.1541011.

TechCity, (2017) The Global Alliance for Clean Cookstoves launches its Catalytic Small Grant program in Nigeria with GSBI Boost Workshop at Wenvovation Hub , Lagos [WWW Document]. Press Release. URL <https://www.techcityng.com/the-global-alliance-for-clean-cookstoves-launches-its-catalytic-small-grant-program-in-nigeria-with-gsbi-boost-workshop-at-wenvovation-hub-lagos/>

Techish Kenya (2019) *Nigeria's cchUB acquires Nairobi's iHub for an Undisclosed amount*, accessed from <https://tech-ish.com/2019/09/26/nigerias-cchub-acquires-nairobis-ihub/> 15th September, 2020.

Wainaina, E., (2016) How CEO Kamal Bhattacharya Envisions iHub 2.0 and its part in the Kenyan Tech Space [WWW Document]. TechWeez. URL <https://techweez.com/2016/11/29/kamal-bhattacharya-on-ihub-2-0/>

Wang, K. H. et al. (2021) 'Is technological innovation making world "Greener"? An evidence from changing growth story of China', *Technological Forecasting and Social Change*, 165(July 2020), p. 120516. doi: 10.1016/j.techfore.2020.120516.

Wangari, B (2015) Inside the iHUB, Kenya's acclaimed "Tech Headquarters" accessed from <https://techpoint.africa/2015/09/15/inside-the-ihub-kenyas-widely-acclaimed-tech-headquarters/> , 15th November 2020

Wenovation Hub, 2020a. The Wenovation Hub Story: a focus on the Ibadan campus.

Wenovation Hub, 2020b. What we have done [WWW Document]. Our Portf. URL <https://wenovationhub.org/portfolio.html>

Wenovation Hub, 2020c. Wenovation hub: empowering African entrepreneurs, building commercially viable business.

Whitt, P. (2016) *How to define and categorize innovation labs*. Available at: <https://www.r4d.org/blog/define-categorize-innovation-labs/>.

Yin, R. K. (2003). Designing case studies. *Qualitative Research Methods*, 359-386.

You, W. et al. (2020) 'The business model of Do-It-Yourself (DIY) laboratories – A triple-layered perspective', *Technological Forecasting and Social Change*. Elsevier, 159(December 2019), p. 120205. doi: 10.1016/j.techfore.2020.120205.