The African Journal of Information Systems

Volume 8 | Issue 4 Article 3

October 2016

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Cover Page Footnote

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The African Journal of Information Systems

Holistic Approach: Paradigm Shift in the Research Agenda for Digitalization of Healthcare in Sub-Saharan Africa

Research Commentary

Volume 8, Issue 4, October 2016, ISSN 1936-0282

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ABSTRACT

Despite significant resources employed in digitalization agenda in the healthcare sector of Sub-Saharan Africa, the transformative impact of information and communication technologies has not been realized. This article makes two contributions towards developing an understanding of this failure. First, it provides a review of a rich body of academic literature and practitioner accounts regarding barriers to digitalization and organizes them using an established framework. Second, recognizing the continuing struggle that digitalization presents, it proposes a paradigmatic shift in thinking about barriers to digitalization and suggests the existence of a more fundamental barrier related to inappropriate incentives within the international community. Ultimately, it argues that unpacking the complex contextual reality of healthcare delivery systems is a fundamental, but still unaddressed, antecedent to any successful digitalization endeavour. Thus, both academia and practitioners should direct their efforts to developing new approaches, which could remove this underlying obstacle.

Keywords (Required)

Sub-Saharan Africa, information and communication technologies (ICT), healthcare, ICT development, information systems research, ICT diffusion, socioeconomic development

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HEALTHCARE DELIVERY IN SSA, FAILURE OF DIGITAL INTERVENTIONS, A PARADIGM SHIFT

Informational infrastructure is a critical antecedent for achieving equity of healthcare delivery in developing countries (Alampay, 2006), and thus, a critical factor in poverty alleviation. Scholars such as Cecchini and Scott (2003), as well as studies by international organizations including the World Bank (Pigato, 2001) and WHO (WHO, 2005) support this view and argue that Information and Communications Technology (ICT), defined as the "set of activities that facilitates the capturing, storage, processing, transmission and display of information by electronic means" (Cecchini and Scott, 2003, p. 73), leads to better decision making and supports poverty eradication endeavours (Bukachi and Pakenham-Walsh, 2007).

The positive socio-economic impact of data-driven decision making, facilitated by effective health information systems is clear (e.g. Ngwenyama et al., 2006; Alampay, 2006; Jennett et al., 2003; Bankole et al., 2011b) with benefits ranging from cost-effectiveness, access, reduced burden on the healthcare delivery system, positive health outcomes to quality of life. However, the presence and efficacy of these systems and applications in developing countries and SSA, in particular, is disappointing (Wamala and Augustine, 2013).

Academics associate this fact with the reality of SSA countries. Countries experienced with exploitation in the colonial years, when the focus was on expropriation of the region's resources rather than education and development (Amin, 1990; Acemoglu and Robinson, 2012). The region suffers from severe constraints on economic growth (World Bank, 2014a). More than 40% of the population is illiterate, poverty ravages with 48.5% of population living below the poverty line (World Bank, 2014b). Communicable and non-communicable diseases prevail (Unwin et al., 2001; Dalal et al., 2011). Researchers, practitioners and international organizations alike argue for the transformative potential that ICT could bring in the areas of healthcare delivery, education, and economic development.

In one of the most cited studies in the field that reviews and analyzes findings on ICT in SSA, Mbarika et al. (2005) argue that while ICT and digital healthcare interventions carry the greatest potential in these least developed countries, they fall significantly behind the developed world in adoption of information systems. The authors develop an "information ecosystem framework for Sub-Saharan Africa" (Mbarika et al., 2005, p. 134) that builds on the work of scholars such as Meso and Duncan (2000) and Wolcott et al. (2001). This framework delineates the overarching steps or factors that must be fulfilled and present for implementation of successful digital endeavours, which will provide the desired social and economic outcomes.

While their information ecosystem provides a cohesive framework for digitalization of SSA and can be considered state-of-the-art, many academics (e.g. Musa et al., 2005; Mantzana et al., 2007; Wamala and Augustine, 2013; Mars, 2013; Sheikh, 2014), including the original authors - Mbarika et al. (2005), elaborate on the significant barriers to successful digitalization through implementation of ICT projects in various areas. According to many of these researchers, the most overarching barrier is related to poor ICT growth, as operationalized by teledensity or the number of landlines. These are now revised to any telecommunication means to include wireless infrastructures much more relevant in the Sub-Saharan context, Musa et al., 2005) per 100 citizens. Access to the Internet had also been found to be prohibitively expensive and a luxury with a mere 2 people per 1000 enjoying access (Jensen, 2001). PC density was also seen as a barrier at a level of 0.1%, as compared to 30% in developed countries

(Oyelaran-Oyeyinka, Lal, 2005). These infrastructure barriers are related to the first stage in the Mbarika et al. (2005) framework and are considered the key bottleneck to digitizing various areas, including healthcare delivery in SSA.

This focus on ICT infrastructure was justifiable in the mid-2000s, however, the present situation in SSA is changing rapidly. Indeed, many sub-Saharan countries now outpace the developed world in terms of mobile ubiquity (Jimoh et al., 2012) (Dutta and Bilbao-Osorio, 2012) (Betjeman et al., 2013). Internet access costs dropped by 50% in the 2010-2012 period making the medium increasingly accessible (Dutta and Bilbao-Osorio, 2012). The wireless leap-frogging is now an established fact (James, 2009).

While a World Economic Forum report on ICT shows that overall ICT readiness in SSA is still low (Dutta and Bilbao-Osorio, 2012), the recent decade was characterised with what can only be called an explosion of ICT projects aimed at various areas of healthcare (Wamala and Augustine, 2013) with significant investments in ICT infrastructure (Bankole et al., 2011b). Yet, the healthcare situation in SSA has been deteriorating. Most of the digital endeavours failed to achieve scalability, sustainability, and faced problems in their implementation to bring the socio-economic impact (Avgerou, 2008; Olajide for the WHO, 2011). Clearly, there must exist additional bottlenecks beyond those identified by the scholars.

Bonair et al., (1989) state that unravelling the reasons behind failures to utilize effectively implemented technologies is one of the most salient concerns about applying technological solutions to the developing world. In this spirit, this work turns to evaluate the existing literature on the barriers to digitalization. The identified barriers are mapped onto the Mbarika et al.'s (2005) "information ecosystem framework for Sub-Saharan Africa".

This assessment, combined with the author's previous endeavours into understanding the antecedents of the failure of IT projects for governmental services, prompted the call for a paradigmatic shift in the way scholars and practitioners think about the challenge of digitalization. Specifically, this study will argue that the barriers identified in the literature, while comprehensive and informative, are insufficient to fully understand and consequently tackle the challenge of realizing the transformative potential of IT. This paradigmatic shift entails embracing the most underlying barrier to digitalization, which the author proposes to be the obfuscated reality behind healthcare delivery systems in SSA (and potentially other countries) and the related lack of incentives for systematically unpacking it. Without a clear and full understanding of the processes that are to be digitalized, overcoming any barriers at later stages of the digitalization process may not ensure the success of the digitalization endeavour. Developing this understanding, however, poses a new set of barriers and requires a new, Holistic Approach to digitalization, which embraces the complex contextual reality of underlying healthcare delivery systems. (see Figure 1 on the next page for a graphic representation of this proposed paradigmatic shift)

The argument will first briefly introduce the theoretical framework of Mbarika et al. (2005) adapted to the context of healthcare. It will then provide an account of the literature and summarize the barriers to digitalization, as currently understood, thereby presenting the existing paradigm. Finally, the argument will move on to exploring the proposed, more underlying barrier, and its associated obstacles, thus establishing the complete paradigm for investigating and addressing the challenges of digitalization in healthcare in SSA. This paper is not intended to propose the practical solution (for a practitioner-oriented paper see Bara-Slupski, 2016), but to direct the attention of IT healthcare scholars and practitioners to a possible explanation for the failure of many IT projects in this area, and a potential new approach to tackling the challenge.

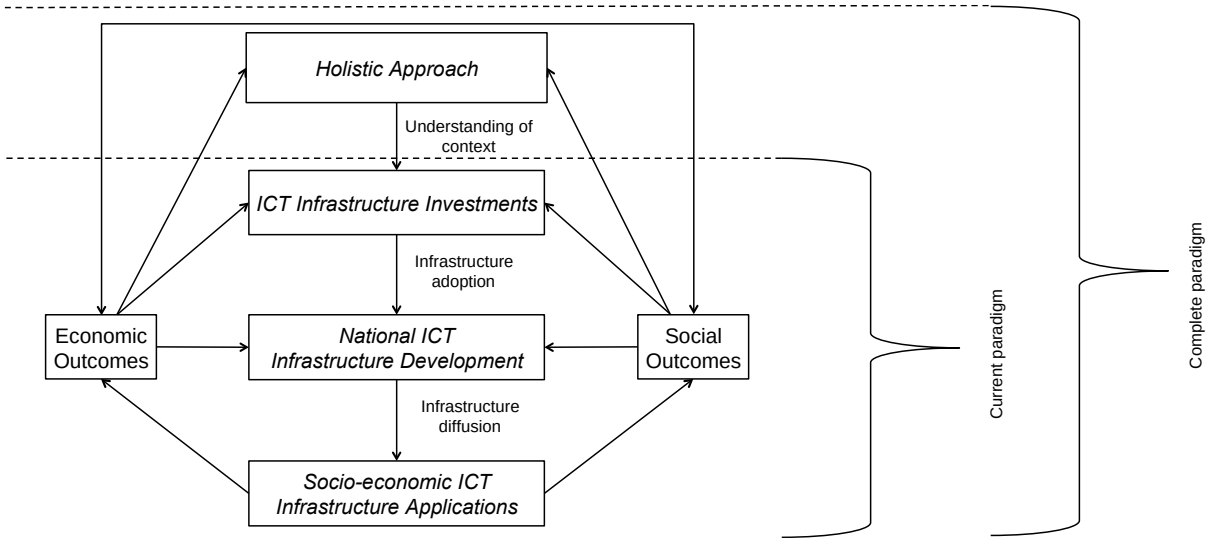

Figure 1 - Proposed paradigmatic shift

CURRENT PARADIGM – THE EXTENDED ICT ECOSYSTEM

ICT for healthcare service delivery has been explored to a large extent in the context of developed countries. However, the academic literature on ICT in the idiosyncratic environment of the SSA region is underdeveloped in comparison (Meso, 2008), despite the recognized potential for ICT to transform the region's healthcare and contribute to its socio-economic development (Ngwenyama et al., 2006; Mars, 2013).

The first representative and influential works on the approaches to digitalization of healthcare delivery services in SSA are those by Odedra (1993a) and Odedra et al. (1993b). Highly cited, the insights by the authors, particularly pertaining to the need for scaling up ICT infrastructure, which has fallen victim of the "donorship" model with little local capability building, provided incentive for researchers to analyze the antecedents and barriers to ICT utilization in SSA. Information Science Journals such as the MISQ, JAIS, EJISDC, JGIM, JGITM contain studies pertaining to specific applications of ICT and barriers to their implementation in areas such as e-commerce (Okoli and Mbarika, 2003), e-government (Schuppan, 2009), education (Hennessy et al., 2010) and healthcare (Meso et al., 2009). While this literature is useful in developing an initial understanding, developing a comprehensive framework for digitalization of healthcare in SSA requires a robust conceptual model as a starting point. Such a framework was developed by Mbarika et al. (2005) as introduced in the first section of this paper and represented in Figure 2 below.

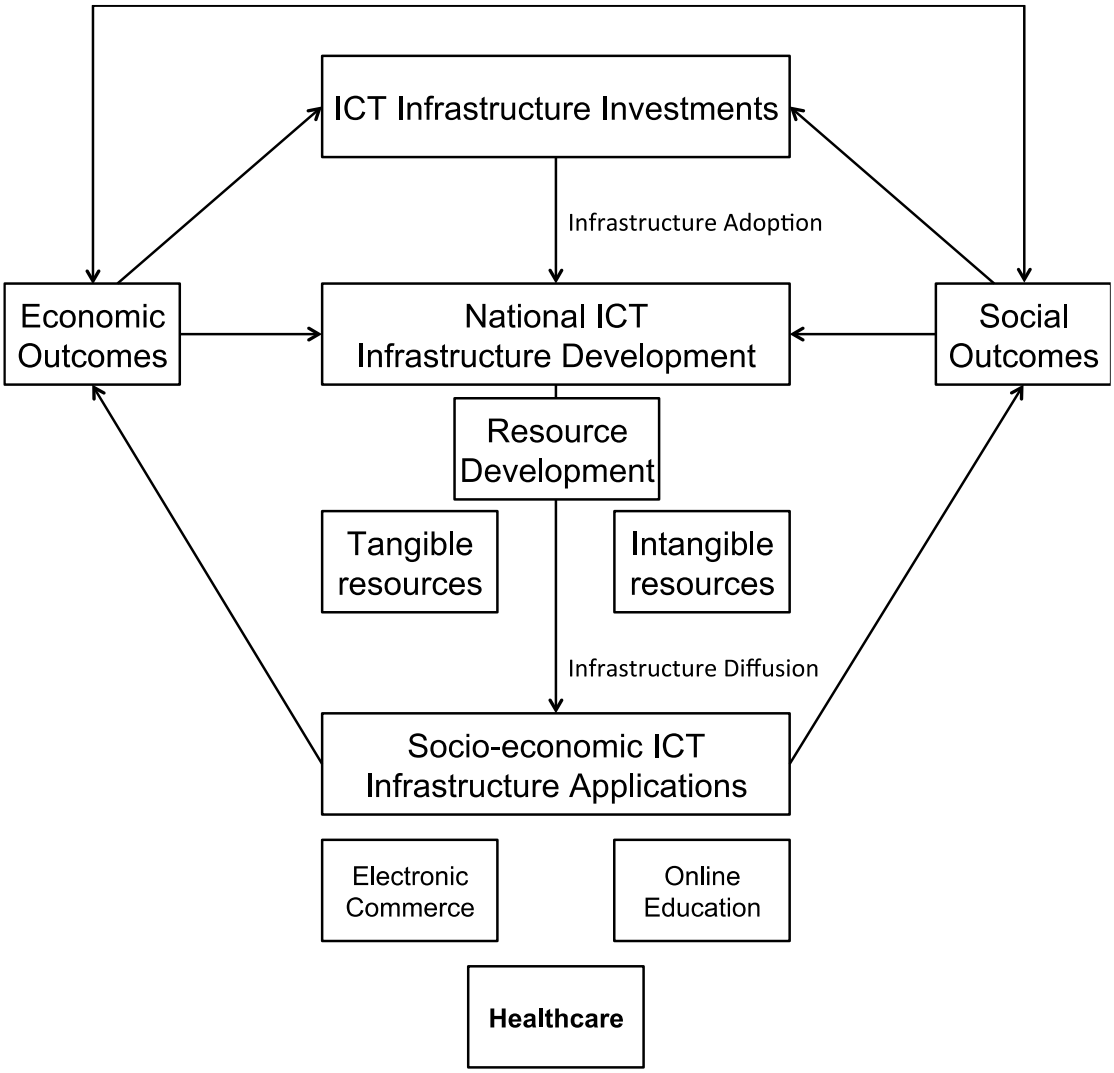

Figure 2 - "ICT ecosystem model for SSA" (adapted from Mbarika et al., 2005, p. 137)

The Mbarika et al. (2005) model is a manifestation of the state-of-the-art literature on the topic derived from flagship Information Technology journals. It encompasses developments in various areas and provides a complete guide for both researchers and practitioners on the digitalization effort in SSA as a cohesive intertwining of the contextual complexity of the environment and the technological solutions. The authors start with the resource-based view of competitive advantage (Barney, 2010) and draw on Bharadawaj (2000) to show that ICT resources form the underpinning source of competitive advantage. Their framework starts with ICT infrastructure investments. Once these ICT investments establish the required infrastructure, they have to be mobilised through adoption and subsequent development and governance to be translated into resources and become a source of socio-economic impact.

Following Grant's (1991) classification of resources, Mbarika et al. (2005) describe them in terms of their tangible and intangible nature in the SSA context. Where the tangible resources relate to the physical ICT infrastructure and are thought to be the key bottleneck in SSA's digitalization endeavour, the intangible ones relate to the supporting processes, synergies and structures of governance that allow for ICT deployment. These resources, when coupled with appropriate human capital employed in their deployment would become a source of sustainable competitive advantage. They would be difficult to

imitate by other countries due to causal ambiguity and time compression diseconomies that would arise in their development and subsequent deployment. The stages of technology diffusion, governance and translation into successful applications depend on sound strategic decisions regarding national ICT adoption and utilization. Authors argue that digital applications, which follow the proposed framework, will bring the positive socio-economic outcomes.

Academics and international organizations show that resolving the dire healthcare situation in SSA is the most critical challenge to bringing the region out of poverty and allowing it to embark on a path towards sustainable development. ICT is then seen as the "great equalizer" (Drucker, 2001; Gebremichael and Jackson, 2006) that can support efficient and effective delivery of healthcare services both to urban and rural areas in SSA (Kifle et al., 2006; Wootton, 2001) where resources and medical personnel are scarce (Rowe et al., 2005).

Fraser et al. (2005) and Cecchini and Scott (2003) further elucidate that of paramount importance is utilization of ICT applications for improving healthcare data flows. Stansfield (2005) and Mutemwa (2005) argue that effective information systems empower decision makers to better utilize and allocate scarce resources. Walsham and Sahay (2006) emphasise the role of data in ensuring quality and responsiveness of healthcare delivery. Therefore, while the potential applications of ICT for improving healthcare delivery systems in SSA are numerous, there exists a consensus in academia that improving healthcare data systems is the critical step in the overall push towards realizing the benefits of digitalization. Transparency and effectiveness of healthcare data flows are essential. Not only do they drive frugal decision making, salient in a low-resource, Sub-Saharan setting, but they also provide the ability to monitor and evaluate the digitalization endeavours aimed at all other areas of healthcare delivery. Ultimately, for the purposes of this study, the author refines the initial ecosystem in Mbarika et al. (2005) to reflect the focus on healthcare and digitalization of data flows in particular (Figure 3 on the next page).

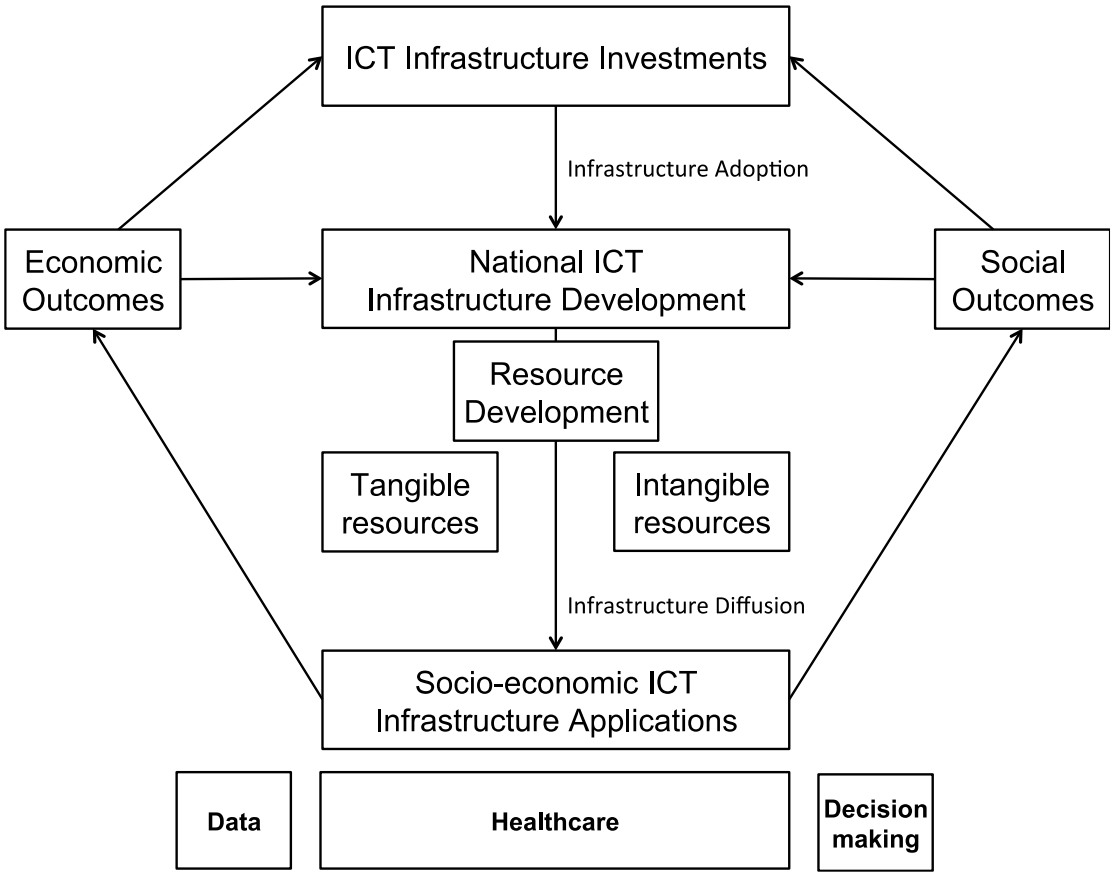

Figure 3 - Healthcare ICT Ecosystem Model (adapted from Mbarika et al., 2005, p. 137)

This framework itself, however, does not incorporate the barriers that arise in the SSA context. The author reviewed the existing literature on barriers to digitalization. These barriers were then put into context of the Mbarika et al..'s (2005) Ecosystem and its consideration of the tangible and intangible resources to create the Extended ICT Ecosystem. It combines both the approach and the potential barriers that any successful digitalization endeavor has to overcome. Figure 4 presents the outcome of this literature review as the Extended ICT Ecosystem:

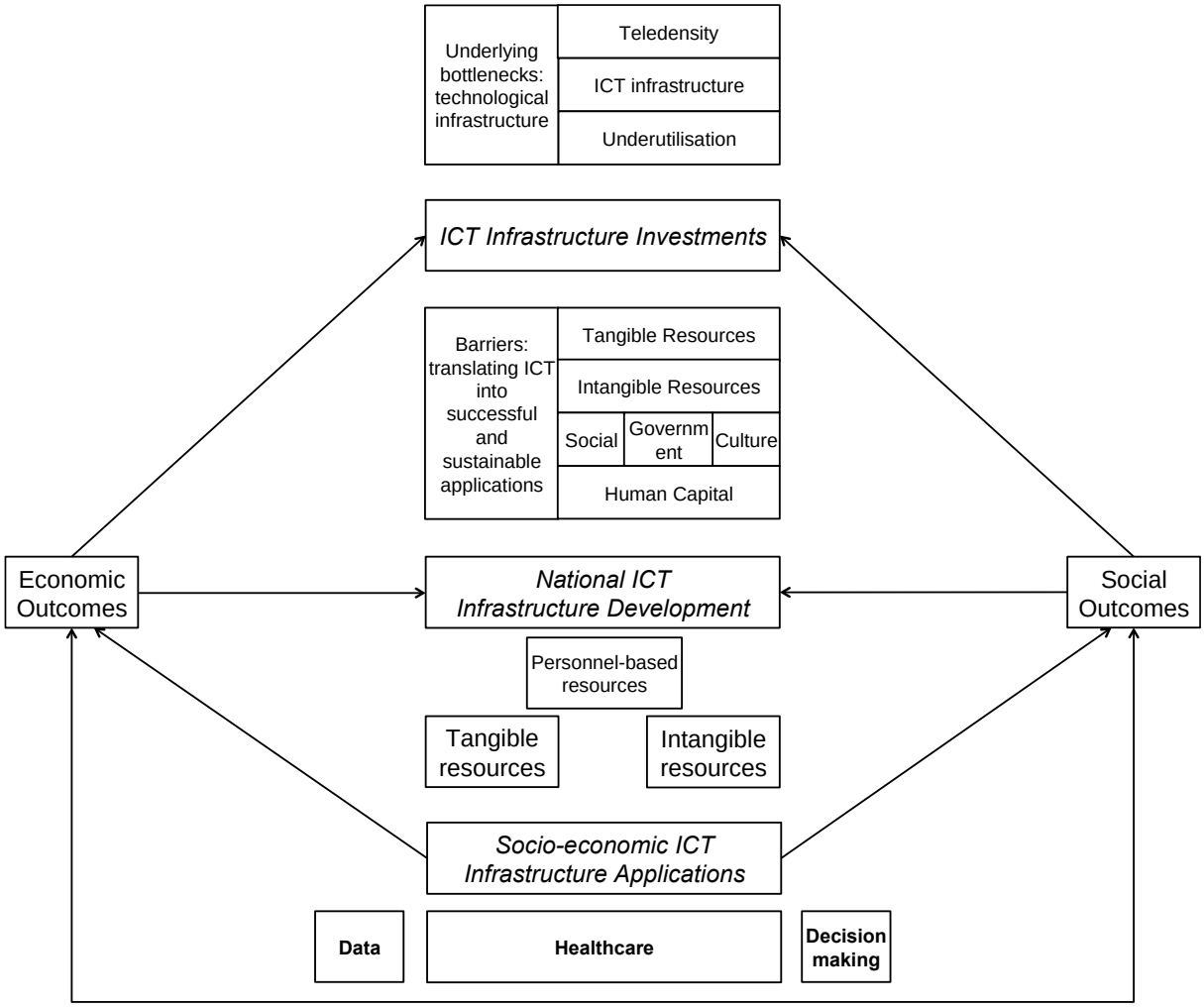

Figure 4 - Extended ICT Ecosystem – a theoretical framework

The next section discusses the outcomes of the literature review and provides further detail on the identified barriers.

REVIEW OF LITERATURE ON BARRIERS TO ICT FOR HEALTH

Barriers in the Extended ICT Ecosystem

The Extended ICT Ecosystem model introduces a complete range of barriers identified in the ICT literature in the literature review process to devise a complete theoretical framework for development and implementation of successful, sustainable and scalable digital healthcare applications within the existing paradigm of digitalization. The initial ecosystem model by Mbarika et al. (2005) explains the particular stages in ICT infrastructure investments, adoption, development, diffusion and application. The extended ecosystem includes the barriers at all of the stages, which pertain to:

1. Existing ICT infrastructure in SSA and investments, their scaling and development for the purposes of digitalization of healthcare service delivery and healthcare data flows in particular.
2. Adoption and development of this ICT infrastructure for the purposes of digitalized healthcare. These barriers are related to the required resources:
    a) *Tangible* – the ICT infrastructure must be translated into tangible resources that when developed and managed appropriately are a source of competitive advantage in the context of the socio-cultural complexity of the SSA setting
    b) *Intangible* – the resources that are embedded in socio-cultural norms and practices of development. These are to complement the tangible resources so that they can become a source of sustainable competitive advantage or in this context – a source of the desired socio-economic outcomes. Intangible resources pertain to the synergies and complementarity of the physical infrastructure with governmental, cultural, social and national norms. If such synergies do not exist, the physical infrastructure cannot be leveraged to build successful ICT healthcare applications and interventions.
    c) *Human capital* – personnel resources developed through training and participation in the development and deployment of the physical infrastructure that support the integration of ICT infrastructure into ICT resources. ICT personnel operates, maintains and develops through innovative ideas the ICT infrastructure to better align it with the needs of the SSA context. Thus, human capital is the source of complementary capabilities that are required to ultimately translate the physical infrastructure into digital healthcare applications that carry the desired socio-economic impact.

In the extended Mbarika et al. (2005) framework ICT infrastructure is seen as the key, overarching bottleneck, to implementation of successful digital healthcare applications. This bottleneck must be overcome through appropriate investments in ICT. Then, through simultaneous deployment of tangible, intangible and personnel-based (human capital) resources, the ICT infrastructure can be successfully adopted and developed to create infrastructure capabilities for the purposes of deploying sustainable and scalable digital healthcare applications/interventions.

However, following this framework does not guarantee success due to the various obstacles that might appear at each of the stages of the process. Therefore, it is imperative to categorize and elucidate them.

Barriers related to ICT Infrastructure and Investments

The poor state of ICT infrastructure in SSA is seen as the overarching bottleneck to digitalization endeavours in the region. Without scaling up the underlying ICT infrastructure there can be no development and implementation of successful digital healthcare applications. The following four barriers in terms of existing infrastructure were derived from the literature and encompass the key aspects of inadequate ICT infrastructure in SSA.

1. *Teledensity.* Teledensity is used as an operationalization of ICT adoption in a country and is considered the "fundamental factor for ICT development" (Mbarika et al., 2005). Lagging

teledensity is, thus, seen as the key obstacle to digitalization of healthcare in SSA. See Bashshur et al.. (2000), Musa et al.. (2005), Mbarika and Byrd (2009), Wamala and Augistine (2013)

2. *Lack of ICT infrastructure.* A plethora of studies points to the simple scarcity of ICT infrastructure in developing countries and SSA in particular that prevents development of successful digital healthcare applications. See Braa et al.. (2007), Barnett and Galegos (2013), Omary et al.. (2009)
3. *Underutilization of existing ICT infrastructure and failure of technology transfer.* Seminal work by Odedra (1993a) points to the fact that much of the existing ICT infrastructure came from foreign aid where technology was dumped on the SSA countries without instruction on how to operate it and it does not reflect their needs. Therefore, the existing infrastructure is underutilized, inadequate and cannot be translated into tangible resources. See Odedra (1993a), Odedra (1993b), Woherem (1991)
4. *Inconsistent power supply.* Energy shortages in SSA and the ineffective solutions such as rotating power supplies inhibit the potential of existing and developing ICT infrastructure. See Rotich et al.. (2003), Eberhard et al.. (2008), Fraser et al.. (2005)

Barriers related to Tangible Resources

ICT infrastructure, even if appropriate and sufficient only becomes a source of rents – allows for the socio-economic impact of digital healthcare applications – if it is translated into tangible infrastructure resources. These resources become a source of competitive advantage when they are "unique" (Mbarika et al., 2005). In the SSA context, resources become unique through their adoption in their idiosyncratic environment where time compression diseconomies, embeddedness in this context and causal ambiguity make them a source of rents and socio-economic outcomes when complemented with intangible resources and the supporting human capital. The following barriers were recognized as inhibiting the process of adopting and recombining the infrastructure into these resources.

1. *Restricted access.* Existing or recently developed ICT infrastructure cannot be translated into ICT resources, because the access to the infrastructure is restricted to elites or relevant actors are precluded from its use. Jensen (2001), Pigato (2001), United Nations (2014)
2. *State-owned monopoly on ICT.* Privatisation of the ICT sector is seen as one of the key drivers of transforming ICT infrastructure into resources and successful digital healthcare applications. State-owned monopolies over infrastructure hinder the digital widespread, efficient adoption. Kimura et al.. (2010), Mlay et al.. (2012)
3. *Prohibitively high access costs.* A factor frequently recognized in the literature is the relatively high access costs borne by actors in SSA as compared to the developed world. Costs that make widespread adoption impossible. This inequality stems from inadequate public policy, economic situation in the SSA and monopolistic structure of telecommunication providers. Adam (1996), Mbarika et al.. (2005)
4. *Regulation promotes vested interests.* While the SSA has suffered from haphazard investments in ICT coming from foreign donors that implemented infrastructure inadequate for its context, some authors point to the fact that new investments perpetuate the problem as unable governments encourage such infrastructure investments. De Boer and Walbeek (1999)

Barriers related to deploying Intangible Resources

These can be catagorized into three broad groups: governmental, cultural and social.

Governmental barriers. Governments of the SSA countries suffer from poor capability. Regulation and policy does not create an environment conducive of supporting the tangible ICT resources for development of successful digital healthcare applications.

1. *Lack of financial resources.* Governments of SSA countries struggle with extremely scarce resources and the healthcare digitalization agenda is not seen as a priority in spending despite the substantial benefits it carries in terms of cost-effectiveness, efficiency and socio-economic impact. Wicklein (1998), Foster (2009)
2. *Lack of policy, strategy and vision.* The digitalization agenda is not made explicit in governmental strategy and is not reflected in policy. Ngulube (2007), Makoza and Chigona (2013)
3. *Lack of regulation on privacy and confidentiality.* Privacy and confidentiality of digitised data for the benefits of healthcare service delivery is not engrained in policy what hinders utilization of the tangible ICT resources and development of successful digital healthcare applications. Omary et al. (2009)
4. *Regulation promotes vested interests.* As noted by Odedra (1993a), many international ICT manufacturers engaged in dumping of inadequate technology at elevated prices with little true technology transfer and after sales support. This was particularly prevalent in light of poor governmental capability, inadequate regulation and opportunism. Odedra (1993a), De Boer and Walbeek (1999)
5. *Lack of government support and central authorities collaboration.* Government officials and other decision-making bodies within the governmental and healthcare service delivery function do not recognize the opportunity that ICT carries and are not inclined to cooperate in development of digital healthcare applications. Gichoya (2005), Braa et al.. (2007), Igira et al.. (2007)

Cultural barriers. Africa is traditionally an oral culture. The transition towards a reading culture and one that could embrace data and digital data in particular for the purposes of improving the healthcare delivery service is still undergoing. This barrier particularly pertains to slow adoption and poor sustainability of digital healthcare applications.

1. *Resources not tied to cultural needs.* The existing infrastructure and ICT resources do not reflect the particular needs of cultural contexts in SSA. These are related to localisation of ICT infrastructure in terms of language but also codes of conduct. Bonair et al.. (1989), Gyamfi (2005), Schuppan (2009)
2. *Lack of data culture.* The cultural contexts in SSA vary and determine the likelihood of adoption and development of tangible ICT resources for healthcare. Lack of data culture makes applications unsustainable as users retreat to culturally embedded modes of operation. See Mutula (2005), Bukachi and Pakenham-Walsh (2007),

Social barriers. Beyond cultural factors, social processes in the SSA, raging socio-economic inequality within the societies leads to disparities in potential for ICT adoption and translation of ICT infrastructure and resources into successful digital healthcare applications.

1. *Relevant actors do not perceive the potential benefits of ICT.* Limited demand for technology… This is related to the cultural dimension of barriers to deployment of intangible resources and represents the overall societal attitude to technology, which is not seen as an enabler of positive socio-economic outcomes. Bonair et al.. (1989), De Boer and Walbeek (1999), Alvord et al.. (2004)
2. *Urban/Rural divide in access and understanding of technology.* For the benefits of digital healthcare applications built upon tangible ICT resources to be realized , access has to be universal rather than confined to rural areas. The urban/rural divide in access is frequently quoted as an obstacle to digitalization. Pigato (2001), Bukachi and Pakenham-Walsh (2007)

Barriers related to Human Capital

Human capital or "Personnel-based resources" (Mbarika et al., 2005) are critical for appropriate deployment of tangible and intangible resources for development, diffusion and application of digital healthcare interventions. The scarcity of human capital, education, ICT literacy and the "brain-drain" are a major obstacle to digitalization of healthcare delivery processes and data flows digitalization in particular. Without local human capital, sustainability of these endeavours cannot be engrained. The following barriers are the key problems related to this overarching barrier.

1. *Lack of ICT personnel.* Underinvestment in education, especially in IT, and "brain-drain" leave SSA a region with poor human resources critical to translation of tangible and intangible assets into capabilities for implementation of impactful digital healthcare applications. See for example Ngulube (2007)
2. *ICT literacy.* While information literacy is seen as indispensable to translation of ICT resources into rent-generating, impactful applications, poor ICT literacy in SSA is quoted as one of the key bottlenecks to development in the information age. See Braaksma (2004), Ngulube (2007), Igira et al., (2007), Ajuwon and Rhine (2008)
3. *Inadequate/lack of ICT training.* Digital healthcare applications, especially those developed in the Western countries and implemented in SSA in a haphazard manner neglect the need of offering appropriate training to local personnel undermining sustainability of the solution. Kuruvilla et al., (2004) and various case study reports of digital healthcare interventions
4. *No local human capital involvement in development process.* Related to the previous barrier, lack of local human capital involvement in development process first undermines sustainability of applications once foreign aid ends. Second, it prevents from scaling up the local human capital. Finally, it hinders adoption and context-specific application development. Norris (2001), Mbarika et al., (2005)

THE COMPLETE PARADIGM – INTRODUCING THE HOLISTIC APPROACH

Beyond the barriers – the underlying barrier

The barriers presented in the literature review above substantiate the initial Mbarika et al.. (2005) framework to provide a complete theoretical tool for analysis and digital application development, are not exhaustive. Still, they are the most overarching issues identified in the literature and contribute to understanding of failure and success of digital healthcare applications. An approach to digitalization of healthcare delivery services and data flows in particular that follows the propositions of this Extended

ICT Evosystem, which addresses these barriers should be implemented and achieve sustainability and scalability.

However, whatever these barriers might be, and however successful a particular solution might be in addressing them, it is unlikely to achieve sustainability unless the work addresses the overarching bottleneck proposed in this article – the obfuscated reality of healthcare delivery systems in SSA.

As the healthcare delivery systems have been growing organically since the Alma Ata Declaration (WHO, 1978) (Gillam, 2008), there is in fact little understanding of the of relationships between the different actors and stages of the healthcare delivery system, the data collection, storage and dissemination processes that were growing and defining themselves in an often haphazard, unstructured and unreported manner. Without reflecting the underlying complexity of healthcare delivery services, the untangled puzzle that persists, applications deployed to address the other significant barriers identified within the contemporary paradigm of digitalization are still prone to failure. Removing these obstacles will be critical to embark on a path towards successful digitalization of healthcare delivery services in SSA, but without addressing this underlying issue, this success is unlikely to materialize in the long term. Therefore, the complexity and lack of understanding of the reality of healthcare delivery systems in the region makes healthcare digitalization endeavours misconceived.

International organizations such as the WHO recognize this problem. A WHO Report on developing health information systems in developing countries (WHO, 2004) calls for investigating the healthcare delivery systems "as is" as part of the digitalization agenda. Nevertheless, the focus remains on data flows and their interactions rather than all the relevant processes that occur within the systems, the hierarchies and interactions among the actors themselves. Similarly, academic studies that attempt to explain the failure and antecedents of success of digital healthcare interventions in SSA start at later stages of the digitalization framework. For example, an extensive review by Omary et al. (2009) provides an understanding of a range of barriers to digitalization. However, the authors begin their analysis with barriers to adoption of digital healthcare applications, specifically "Challenges to e-healthcare adoption" (Omary et al., 2009, p. 204). They do not address what these applications ultimately pertain to the underlying healthcare delivery system seen as one complex intertwining of actors, processes, infrastructure, tangible and intangible resources, cultural, social, and economic context.

The complete paradigm and Holistic Approach

The Holistic Approach requires taking, as a point of entry, a thorough understanding of the healthcare delivery system in its entirety before any ICT investments are made or considerations given to deploying tangible and intangible resources. It requires embedding the knowledge of the system's artefacts within a broad and deep understanding of its context without neglecting the interactions and processes that govern these artefacts, which ultimately allow for delivering the governmental service.

This is to be done by first engaging in comprehensive healthcare delivery service mapping. These maps must take form of comprehensive flow-diagrams that represent all of the actors, data points and interactions among them within the country. Second, data flow maps must be developed in a similar fashion. These data flow maps should encapsulate all data that exist, that is currently gathered in terms of depth and breadth and how and when the actors identified in the first stage of the process use it. This will ensure that all these relevant actors, processes and data points are included in the digitalization endeavour that follows the premises of the Extended ICT Ecosystem. In other words, included in appropriate ICT infrastructure investments, translation of these investments into tangible and intangible

assets that, with adequate human capital, can be deployed for developing successful, sustainable and scalable digital healthcare applications. See Table 1 below for a representation of the logic of the Holistic Approach.

Healthcare Service Delivery	• Investigate the current interactions among all the actors within the healthcare delivery system – disentangle all the institutional processes at the macro and micro level encompassing the public and private sector • Map the healthcare delivery service as is	Healthcare Service Delivery Map
Healthcare Data Flows	• Analyse data that is already stored and has been accumulating in the past • Analyse the data that is continuously produced • Map the data flow to identify relationships between the datapoints	Data Flows Map
Digitalisation phase	• Analyse the gaps in the incumbent system as they appear from the mapping processes from the previous stages • Develop data architecture and modelling tools that encompass all the understanding to design a clear and uniform way of capturing data that will relate to and resonate with the old data infrastructure that existed • Follow propositions of the current paradigm	Digital solutions, contemporary output-based measures

Table 1 - Logic of the Holistic Approach

Therefore, the Holistic Approach considered in the context of the Extended ICT Ecosystem shows that the current paradigm is incomplete. Thus, it requires an outward shift in thinking about the challenge of digitalization and reveals the underlying barrier. The Holistic Approach is presented in Figure 5 as part of the complete paradigm for digitalization of healthcare delivery.

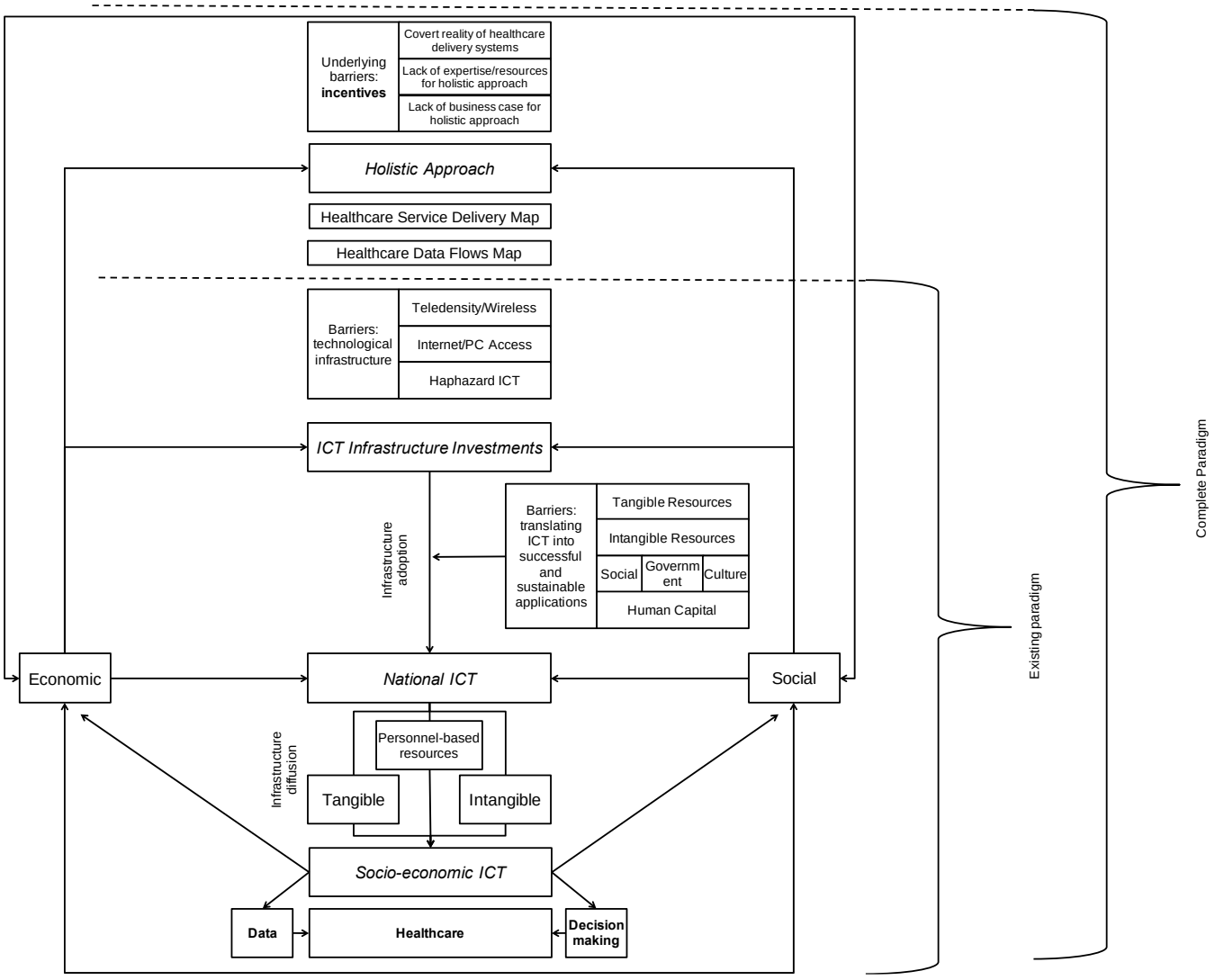

Figure 5 - The complete paradigm and Holistic Approach

The Holistic Approach, however, brings additional challenges to digitalization of healthcare in SSA. Unravelling the underlying complexity of healthcare delivery services and mapping them in a systematic way requires significant resources and expertise SSA countries are consistently found to lack. Such projects might take many years to complete and the direct economic and social benefits cannot be easily quantified or anticipated. The key barriers to embracing the called for paradigmatic shift and making the Holistic Approach a reality are:

1. *Covert reality of healthcare delivery systems.* This is the underlying bottleneck to digitalization of SSA identified in this study. While the Holistic Approach carries the opportunity to refocus the effort of scholars and practitioners to overcoming this barrier, in itself it poses a significant challenge. Governmental functions that support healthcare delivery in SSA are often unstable with high staff rotation even in the higher positions. Access to relevant actors within governmental and service delivery structures is restricted, especially to foreign practitioners.

Sociological and cultural differences pose a challenge to conducting the mapping processes. Ultimately, access to the healthcare delivery service is restricted often to actors who do not have the capability or inclination to engage in untangling this underlying complexity.

2. *Lack of expertise/resources for Holistic Approach.* This obstacle resembles the propositions derived from the literature on barriers to digitalization of healthcare in general. SSA countries suffer from poor governmental capacity and overall human capital to engage in the digitalization endeavour as elucidated in this study. Clearly, a similar bottleneck is true of the propositions of the Holistic Approach. A project that develops a complete map of the healthcare delivery service requires significant resources both in terms of expertise as well as funding.

   Therefore, foreign expertise and resources required for process mapping are essential to lay the foundation for subsequent digitalization. This, however, relates to the final and perhaps most important obstacle to implementation of the approach.

3. *Lack of business case for Holistic Approach.* Mapping of the healthcare delivery and data processes in SSA is a formidable challenge. It requires significant resources and commitment of human capital. The return on this investment is unlikely to realize over the short-term. While beyond the scope of this paper, the problems of management myopia and short-termist, shareholder-value driven outlook of multinational enterprises may prevent large IT organizations from engaging in the endeavour. At the same time, these are the organizations that have the capability and expertise to engage in successful projects that would push the Holistic agenda forward. It can be argued that this is one of the reasons for the early criticism of multinationals by Odedra (1993b) who claims that such companies tend to dump technology on SSA countries to realize profits without the subsequent support that such technology requires to bring the socio-economic benefits in light of severe resource constraints in this context.

   In the international development arena, incentive structures often resemble those in the financialised private sector. Focus on short-term, output-based projects that deliver measurable outcomes does not incentivise long-term undertakings that provide indirect benefits.

The complete paradigm reveals the underlying barrier to digitalization of healthcare in SSA to be the issue of incentives. Without vision, commitment and collaboration of donors, international organizations, technology sector MNEs, manufacturers, distributors and consultants of IT systems, long-term commitment and engagement of international organizations the Holistic Approach will be difficult to realize.

The international development sector is operating on already stretched resources. Engaging in short-term, output-based endeavours in the digitalization arena detracts the community from building a strong foundation for their future success. Taking a long-term perspective and accepting the need for building such a foundation makes it clear that current endeavours do not make the appropriate use of scarce resources. This poses a challenge in itself. The development community is highly complex, with thousands of stakeholders with different objectives, strategies and goals. A potential collective action problem may also arise if some organizations opportunistically continue attracting donors to short-term, relatively "easy win", but misaligned projects.

DIRECTIONS FOR FUTURE RESEARCH

The digitalization agenda is becoming increasingly engrained both in local policy and the strategic direction of international organizations. It can be argued that digitalization of healthcare in SSA is inevitable. The lack of contextual understanding and a systemic approach to obtaining it are the overarching bottlenecks to deploying successful digital solutions in the region. It becomes apparent that funding of projects that do not address this underlying issue is misguided.

The global community faces a significant challenge in realigning the incentives prevalent in the international development sector. A thorough intellectual effort is required to underscore the importance of taking a long-term, systemic approach to resolving the persistent inefficacy in deploying the transformative potential of ICT in healthcare in SSA. At the same time the short-comings of projects delivering to output based targets must be elucidated further.

Existing research proves useful in understanding the obstacles to digitalization that can be overcome through targeted digital interventions that are essential for future success of the whole digitalization endeavour. However, there remains a yearning for scholarly discourse that would guide the global community towards a more measured, patient and less short-term oriented approach. This work suggests a structure for thinking about the future of digitalization and aims to encourage academics in the field of ICT for health to work on developing ideas that would help realign the incentives and enable the unpacking of the complex contextual reality of healthcare delivery systems in SSA.

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