Reflections on Post Hoc Theorization of ICT4D Action Research Projects

Research-in-Progress

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Abstract. Action research is thought to be a useful methodology for knowledge creation in ICT4D research. Researchers applying this methodology may use *post hoc* theorization, that is, applying theoretical lenses to make sense of the outcomes of the action research interventions after the research is done. In this paper we compare two alternative approaches to the process of post hoc theorizing using a case study of an action research project based in Africa that focuses on developing robust research infrastructures for open science. We employ both actor-network theory concepts used in ICT4D research on large scale infrastructure projects and Activity Theory concepts for the analysis. Separately and complementarily, they are found to offer the potential to theorize the case study's "theory of change" and approach to action research.

Keywords: Action Research in ICT4D, Open Research, Research Infrastructures, Actor-Network Theory, Activity Theory

1   Introduction

Action research is thought to be a useful methodology for knowledge creation in ICT4D research, although potentially not widely embraced due to issues with rigor and theory development [1, 2]. In this paper our focus is not on theory-driven designs for action research [3], but on *post hoc* theorization, that is, a sensemaking process involving the application of, and engagement with, theoretical or conceptual lenses after the research has taken place, a practice which acknowledges the often unplanned nature of this methodology [4]. There is a rich tradition of such post hoc theorization in ICT4D action research projects, mostly related to large-scale infrastructure design and development in developing country contexts. They involve immersive research in the context and the work practices of the study settings, but then draw upon some key theoretical concepts which are further theorized with insights from the projects being studied [5]. In these cases, action research post hoc theorization helps not only to shed light on the theories of change inherent in the projects but also contribute to the development of the theoretical framing that is itself being used [5–9]. By "theory of change" we refer to "how and why socio-technical changes may take place in a certain context" [10] (p. 6).

This paper compares two alternative approaches to the process of theorizing the outcomes of a seven-year action research project in Africa. The project is an advocacy and agenda-setting initiative aimed at strengthening research infrastructures in the African research and higher education sector through the mobilization of resources embedded in loosely-formed networks of stakeholders who share an interest in the broad goals/objectives of the initiative. The paper will first present the case study and a synthesis of several important aspects of the initiative that could be of theoretical significance. It will then apply concepts from two theories, Actor Network Theory (ANT), which has been used previously as a theoretical lens for action research projects within ICT4D [11] and Activity Theory (AT), seen as a potentially promising approach for theorizing action research projects [12]. The guiding research question is: *how can post hoc theorization offer revelatory insights into practice-based ICT4D action research projects.*

2   The Case Study

The case study is a pan-African initiative called LIBSENSE [13] (an acronym for "Library Support for Embedding NREN Services and e-Infrastructure") funded by Africa-Connect [14], a large infrastructural program to provide the "last mile" connectivity of African higher education and research institutions to existing research and education networks in Europe. To support this aim, various research and education network (REN) organizations were instituted in Africa to provide coordinating structures through which network connectivity could be diffused to higher education institutions [15]. This REN formula had worked in Europe and was seen as a potentially successful intervention in other LMIC contexts [16], in particular, in Eastern/Southern Africa, and in the West African region, which is the focus of the case study.

LIBSENSE was spearheaded in 2017 by the West and Central African Research and Education Network (WACREN) [17] in partnership with two NGOs, Electronic Information for Libraries (EIFL) [18] and Confederation of Open Access Repositories (COAR) [19], and the University of Sheffield (UoS) Information School. All the partners had previous working experience on European Commission projects with a focus on librarian communities. Given WACREN's remit as a coordinating body for 22 West African countries, their primary interest was in advocating for REN services such as federated networks, broadband connectivity, high performance computing, and building standards for next generation open access repositories. UoS was entrusted with research activities to investigate the challenges faced by the librarian communities in adopting open access/science policies and practices.

Eventually, LIBSENSE would evolve three organizing pillars covering: infrastructure development (open access journals, repositories for publications and data and open discovery services), policy development (open science policies, governance and leadership) and capacity building (communities of practice and training) [13]. The main activities were advocacy and awareness-raising workshops bringing together academic librarians with technical experts from the RENs. A key message was that technology would be no problem while RENs were involved in providing infrastructure needs,

however, uptake and implementation of new standards and processes around open access/science would need to be catalyzed. Currently, LIBSENSE is focusing on agenda-setting, i.e., actively influencing future policy on how open science would evolve in higher education and research institutions. LIBSENSE, for example, is partnering with UNESCO on implementing their recommendations on open science [20], and hosting open science policy development workshops with senior university executives [21]. In collaboration with RUFORUM, a pan-African network of agricultural research institutions, LIBSENSE will develop and pilot an agricultural research data repository [22]. One of the most recent workshops focused on research assessment reform and highlighted the success of Latin American forums as exemplars for other Global South endeavors at reforming established research practices [23]. Figure 1 presents a timeline mapping some key activities and events from the inception of the LIBSENSE initiative and covering the period in which it was funded by the AfricaConnect2 program. Figure 2 extends this timeline covering the period funded by AfricaConnect3. Figure 3 demonstrates the overall strategy, organization and direction of the initiative, which is conceptualized as a combination of grassroots "bottom-up", community-based actions and policy-driven, executive "top-down" decision-making actions. The initiative aims to influence both ends of the pyramid in tandem.
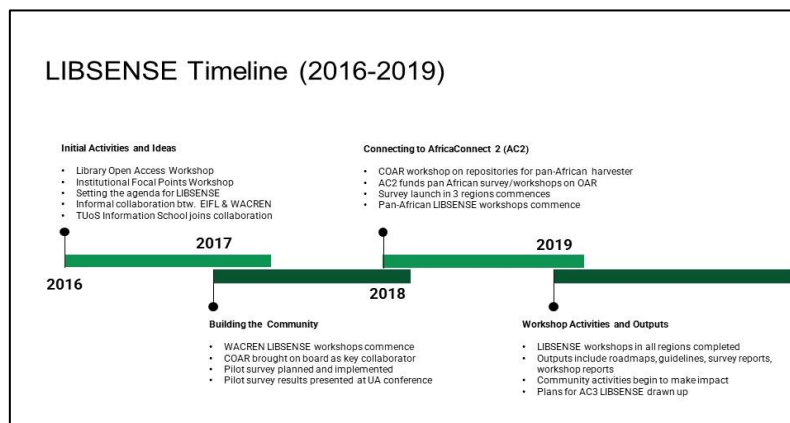
Fig. 1. A timeline of growth and key activities undertaken by LIBSENSE during the African-Connect2 program (2018-2019).
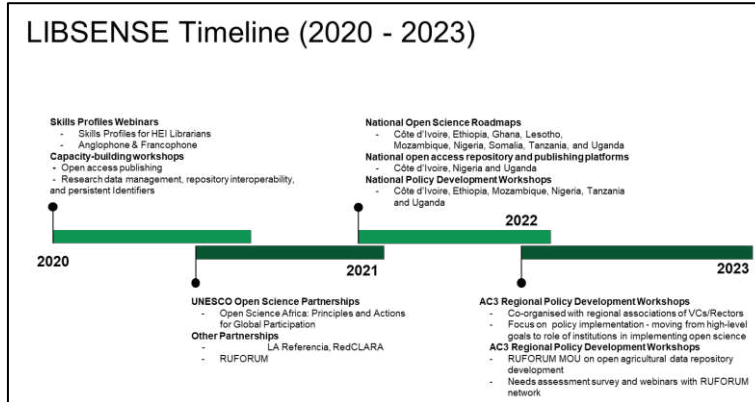
Fig. 2. A timeline of further development and key activities undertaken by LIBSENSE during the AfricanConnect3 program (2020 – 2023).
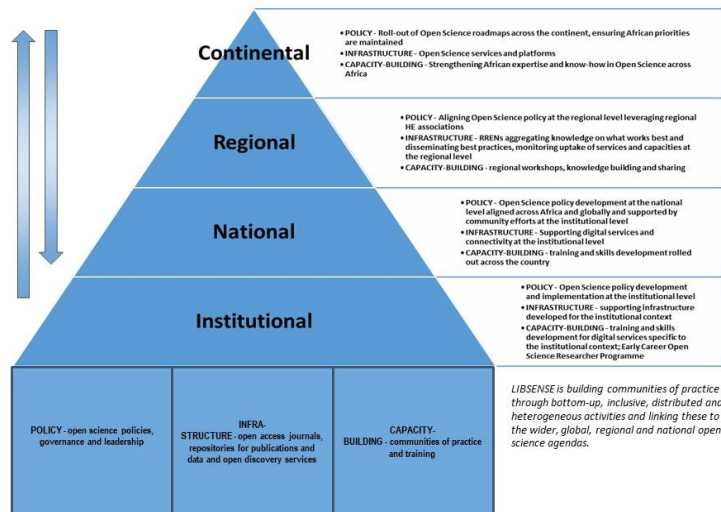
Fig. 3. A schematic of the bottom-up/top-down approach to addressing the LIBSENSE open science agenda across Africa.

2.1 Key Elements of the Case Study

Some key elements can be drawn from the case study, which seem relevant to analyze and understand through theorization:

1. The case study represents actions that are taking place due to *shared goals and objectives of a network of actors*. These *goals are subject to change* depending on the

composition of the network at any point in time, e.g., if stakeholders join the network to achieve a specific outcome in line with their own interests [24].

2. Although subject to change, these *goals broadly encompass the open research agenda* [20] and notions of *cognitive justice related to enhancing the global visibility of African scholarship* [25, 26].

3. One of the aims of this initiative is the *co-development of research infrastructure*, i.e., the building of physical and digital infrastructure on which services can be mobilized which themselves shape the research environment, e.g. the RUFORUM open date collaborative project [22].

4. The initiative benefits from the *contingent nature of the interactions, connections, relationships that are developed within the network and beyond*, spawning projects, linkages, partnerships etc. that work together towards shared goals [24].

5. There is *fragility but also sustainability in the network*; structures are developed, like the RENs, but are very dependent on heroic efforts of individuals to sustain them; institutions are weak in their support, sustained activity is dependent on external funding, undermined by a constantly changing context e.g., librarian's professions (digitalization effects, e.g.), publishing (industry, access etc.) [27].

3   Applying Post Hoc Theorization

3.1   Perspectives from Actor-Network Theory

There is an existing body of research in ICT4D studies adhering to Actor-Network Theory (ANT) that stems from the HISP project (a large-scale infrastructure-based project around developing health information systems in the global South) by colleagues from the University of Oslo which has had a significant influence on the theorization of action research projects [5–9]. Much of this work has utilized the concept of Information Infrastructures (IIs), which itself incorporates concepts from ANT [28, 29] as a theoretical basis for analysis and conceptualization [6]. It has also been influential in theorizing the action research process [7]. ANT is thought to be quite relevant to the study of information systems due to its focus on heterogeneous actor-networks which encompass social and technical elements at different levels of granularity, e.g. employees, organizations, systems [1, 30, 31]. In this paper we draw upon two useful conceptualizations thought relevant to post hoc theorization of the LIBSENSE case study: Networks of Action [7] and Information Infrastructures [6, 29], which adopt similar ANT constructs with slight adaptations as explained below.

From the *networks of action* perspective, Braa et al. conceptualize action research as consisting of cumulative and transformative action taken within interconnected and embedded networks [7]. They draw upon ANT notions of transcription, translation and alignment [32, 33]:

- Transcription - subsumes the notion of inscription, or "the way in which technical artefacts embody patterns of use" [28](p. 76).
- Translation - tracing actors' motivations and alliances in ensuring their interests are aligned with various actor-networks within the study context [28, 31]. According to

Braa et al. [7], networks of action can be realized through two kinds of translation – horizontal and vertical - "translation takes place both vertically through local appropriation and horizontally as artefacts and routines spread to new sites" (p. 342).

- Alignment - "alignment is a relative measure of the extent to which the agendas and interests inscribing into the practices, institutions, and strategies of the network pull in the same direction, and serve the same purpose" [7] (p. 342).

Through these concepts the researchers are therefore able to understand experiential learning and sharing across the actor-networks constituting the context of their study. "In sum, the notion of networks of action is intended to capture the dynamics of translating, aligning heterogeneous networks of routines, technology, and learning within politically contested terrains of opposing projects and ideologies in an effort to promote sustainable, replicable changes." (p. 342).

The process of developing and deploying any *information infrastructure* is one of negotiating technical decisions based on actors' social relations [6, 34]. ANT has been used in this body of literature to trace these underlying social processes [29, 31, 34]. The concepts from ANT used in this literature include:

- Inscription - assumptions made about how the technology to be used is embedded in its design, but only realized when the technology is actually in use and subject to some interpretative flexibility by the user.
- Translation – the way in which we reinterpret and appropriate the anticipated use embodied in technological artefacts to our own interests, which may for example result in unintended consequences of technology's use.
- Irreversibility and institutionalization - seen as parts of same phenomenon, relating to how the infrastructure develops a pattern of use that is resistant to change.

The key concepts in the Networks of Action and Information Infrastructures theoretical lenses can help us to address all five of the key case study elements. The concepts of translation and alignment that are part of the Networks of Action approach, for example, can help to explain how LIBSENSE shared goals and objectives have emerged from the varied interests of the partners and stakeholders or how these become manifest in the informal and formal structures being adopted by the initiative to manage the realization of tangible outcomes. Key concepts from II conceptualizations can help to understand, for example, how inscribed design decisions in research infrastructures and political alignment of policy- and decision-makers can enable or constrain social justice outcomes for the infrastructure-based services developed for Research and Education institutions.

3.2   Perspectives from Activity Theory

An alternative theory that has been applied to the context of ICT4D, action research, the complex world of initiatives, and IS research is Activity Theory (AT) [35, 36]. Activity theory helps us as social scientists to uncover the deeper structures and mechanisms, practices and processes that drive social phenomena [37].

Using activity as a unit of analysis, AT provides a set of interacting elements that include subject, object, tools, rules, community, division of labour, and outcome. Furthermore, AT consists of a set of basic principles: 1) object-orientated human activity; 2) multi-voicedness; 3) historicity; 4) contradictions; and 5) transformations [38]. Drawing on these interacting elements and basic principles, "an activity system is the site for analysing interaction between actors and collective structures and the use of tools, providing an analytical framework for studying the specific activity and practices at a multilevel, stratified manner, in context" [39] (p.531).

The multilevel involvement of stakeholders in initiatives such as LIBSENSE invites scholars to consider a suitable theory that can transcend a single level of analysis and that considers the context of the phenomenon of interest. Activity Theory is deemed appropriate in which to analyse the multilevel phenomenon of an initiative as it offers a visual model (unlike other theories) that enables a holistic analysis of the multilevel phenomena influencing the activity process [40], and develops a "nuanced understanding of the relationship between ICT artifacts and purposeful individuals taking into account the environment, culture, motivations, and complexity of real-life settings" [41] (p.11).

Activity Theory can be used as an analytical framework to provide a theoretical multi-level perspective of the collective action of an initiative [42]. This helps to understand the elements of an initiative within the levels and between the levels, while identifying contradictions which provide insights on change and development within an activity [43]. This allows us to go beyond narrow conceptualisations of digital artifacts, by viewing them instead as consisting of both technical and social/organizational elements, where there are opportunities for change. This could include "distributed actors and boundary resources, which are collectively used and created by the community of actors and which also regulate the relationships between them" [44] (p.597).

Drawing on AT concepts, Figure 4 below captures one potential view of an AT analysis of the LIBSENSE initiative.

4   Discussion and Conclusion

ANT has been used extensively for post hoc theorisation of ICT4D action research within the context of large-scale infrastructure development and deployment. For the LIBSENSE case study, ANT, through the networks of action and II concepts, is particularly well suited for analysing emergent and contingent networked relationships, influences of alliances and vested interests on design, development and implementation of the digital infrastructures, without privileging the social or technical in the resulting ensembles of processes, practices and routines that may be the result of the initiative [5]. AT helps to provide a granular analysis of the dynamics, processes, experiences and behaviours of those involved in the initiative, integrating the perspectives of stakeholders that operate at different levels to provide an understanding of it as a multilevel phenomenon [40]. Both theoretical lenses can help to frame the initiative's "theory of change" as an ensemble of networked sociotechnical relationships (ANT) or as interrelated multilevel activity systems (AT). Combining the micro perspective of ANT with

the multilevel view of AT could provide a complementary lens that not only reveals how actors connect and codevelop tangible outcomes in the emergent process of action research but also how this is being manifested at different but intersecting levels of analysis. Such a complementary perspective can be used to richly conceptualise the contours of the action research being undertaken in the project, complementing the network view with an integrated, multilevel view. The rich insights gained from this work can also be used to refine the resulting concepts used to develop "theories of change" and understand ICT4D action research, thus contributing to the evolution of ICT4D action research theorization.

Level AT Elements	Regional/Continental Level activity system	National Level activity system	Institutional Level activity system
Subject	Regional/continental stakeholders, e.g. RRENs, RUFORUM	National stakeholders - NRENs	Institutional stakeholders, e.g. HE librarians
Object	Implementation of open research infrastructure & advocacy of Libsense objectives to wider communities and network	Provide supporting environment for policy makers and institutions on open research, provide enabling environment for development and implementation of research infrastructure	Development of open research policies and guidelines, support capacity building and skills training
Outcome	Improving the sustainable alignment of open science research capabilities and resources across Africa resulting in greater visibility of African research globally	Greater alignment of national open science roadmaps to the UNESCO recommendations on open science	Improved capacity for delivering open science objectives, opening up alternative avenues for research assessment based on open science values
Tools	Pan-African open access repositories, open publishing platforms and open data repositories	National open access repositories, open publishing platforms and open data repositories, national initiatives/plans for open science implementation, national open science colloquia	Skills development workshops, open educational resources, RDM training
Rules/ Norms	Political environment; Pan-African governance mechanisms; Regional funding mechanisms; Regional collaborations and networks; societal & cultural norms	Funding landscape & political environment; national research-related policy & practice; establishing partnerships; governance mechanisms; sustainability; societal & cultural norms	Policy and guidelines; institutional norms; institutional funding mechanisms; hidden costs behind research lifecycle; librarians' professional practice
Community	Pan-African and regional policy influencers; networks; international funding bodies; Regional RENs; Research and higher education institutions; European Commission actors	Governments & national organisations; institutional organisations; national and international funding bodies; networks; telecommunications providers; Research and higher education institutions	Librarian consortia; NREN focal actors; providers of CPD; academics and researchers; ECRs; Senior research and education executives; institutional IT providers
Division of Labour	Pan-African and regional policy influencers; LIBSENSE international partners; Regional RENs; European Commission actors; Research and higher education institutions	National government and policymakers; national and international funding bodies; telecommunications providers; Research and higher education institutions; national HE librraian associations	Librarian consortia; NREN focal actors; providers of CPD; academics and researchers; ECRs; Senior research and education executives; institutional IT providers

Fig. 4. An AT analysis of LIBSENSE

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