

Infrastructuring in a Socially Just Way: Lessons Learnt from a Grassroots Open Science Initiative in Africa

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Abstract

Open science could be seen as a mechanism to address knowledge production and dissemination issues thought to affect problematic and inequitable levels of African research visibility and productivity. Implementing such solutions, however, depends greatly on creating the research infrastructures that can support such an approach in appropriate ways. A key research problem emerges as to how to do infrastructuring work in this context in such a way that it promotes more sustainable, socially just and equitable outcomes. The essay will address this problem by proposing a framework for doing infrastructuring work in a socially just way and illustrating how it could be used through an examination of action research outcomes of a grassroots African open science initiative called LIBSENSE. Using the framework, an archive of documentation of LIBSENSE interventions and actions over a 7-year period are analysed. The results point to both affirmative and transformative infrastructuring work that align with social justice tenets, with the caveat, however, of a challenge to long-lasting, sustainable change.

Keywords: social justice, infrastructuring, open science

Introduction

Unequal levels of research visibility and productivity from the African continent as compared with other countries where such metrics are being collated have long been deemed to be problematic and inequitable (Gaillard & Mouton, 2022; Nwagwu, 2008; Tijssen, 2007). While it is acknowledged that low research visibility may be due to lack of discoverability in mainstream research output databases such as Web of Science and Scopus (Asubiaro & Onaolapo, 2023; Tennant, 2020), there is still a question as to whether lower research productivity may also be contributing to this issue, i.e., lack of output also leading to lack of visibility. This perceived lack of productivity could be the result of poor investment in resources, infrastructures and policies to support research across the continent (Ngongalah et al., 2018; Ocholla, 2011).

One way of addressing these issues has been through the promotion of open science as a means of both providing more accessible channels for dissemination of research outputs through green open access, for example, and for reforming the way science is done, through incentivising research differently (Mwelwa et al., 2020). Open science could therefore be a mechanism to address both the production and dissemination issues thought to exist in the African research context.

Research problem

Implementing open science, however, depends greatly on creating the research infrastructures that can support such an approach in appropriate ways. To deliver the expected seamlessness of open platforms, these infrastructures, in turn, depend on digital technologies and the underpinning digital readiness to support them. As so often happens, however, due to unequal access across the African continent to these technologies as compared to other countries, often referred to as a global digital divide issue (Gwynn, 2019), sustainable construction of appropriate systems and supporting processes is often difficult to achieve. We refer to this process loosely as infrastructuring work, which is explained further below. Another less visible issue is the potential for additional inequities to be built into the infrastructuring work done to achieve open science goals due, in part, to a failure to recognise systemic injustices that may influence the outcomes of such work. Existing cognitive injustices and postcolonial knowledge hegemonies are already seen to influence what knowledges are produced and disseminated globally (Nyamnjoh, 2012; Piron et al., 2016). In these contexts, the West is seen to dominate science and technology and the means of producing and disseminating knowledge. The key research problem then becomes how to do infrastructuring work in this context in such a way that it promotes more sustainable, socially just and equitable outcomes.

Objective

The essay will address this problem by proposing a framework for doing infrastructuring work in a socially just way and illustrating how it could be used through an examination of action research outcomes of a grassroots African open science initiative called LIBSENSE. This project has been sponsored by AfricaConnect (AfricaConnect, n.d.), a research infrastructure strengthening programme sponsored by the European Union, and undertaken by research and education network (REN) organisations across Africa in the past 7 years.

Literature review

Information infrastructures and research infrastructures

Research related to information infrastructures (IIs) evolved from a need to understand the socio-technical relationships and dynamics engendered by the pervasive development

and commissioning of large-scale computerised network infrastructures like the Internet (Edwards et al., 2009; Hanseth & Monteiro, 1998). These computerised networks provided the basis for the convergence of information and communication technologies (ICTs) and thus the emergence of new processes and practices realised by their affordances (Hanseth & Monteiro, 1998). A technical definition of IIs incorporates terms such as cyberinfrastructure or e-infrastructure, which emphasise the technical elements such as computer networking hardware, protocols and standards that enable connectivity, interoperability and standardisation (Kee et al., 2011), all of which are essential building blocks for many applications supported by ICTs. Initial work done by Star and colleagues (Star & Bowker, 2002; Star & Ruhleder, 1996) attempted to define the scope and complexity of IIs as large sociotechnical assemblages whose function became more defined as they became embedded in processes that people used to organise their work and social activities. Star and colleagues were keen to move the conceptualisation of IIs beyond their technical elements and their correlation with “substrates” or “scaffolding”, all of which suggested a “background” to social processes. Rather, they presented IIs as active agents in shaping and forming the processes that would eventually be supported by their underlying technical elements.

Following on from the seminal work by Star and colleagues, a considerable research stream has developed which generally supports the stance that IIs are relational in nature and that they encompass both social and technical elements in complex ways which are intertwined and context dependent. Research by scholars from the University of Oslo (Braa et al., 2007; Bygstad, 2010; Hanseth et al., 1996; Monteiro et al., 2014; Sahay et al., 2013) revisits a recurring theme in II discourse concerning dialectical tensions that IIs are thought to conceptually embody. The notion of flexible standards, e.g., is one such tension (Braa et al., 2007; Hanseth et al., 1996). IIs need to incorporate both the capability to grow and change (flexibility) to support new uses, processes and practices as they emerge with the use of the infrastructure and they also need to provide stable structures (standardisation) through which application providers can build on and improve services made available through the II. Another tension which IIs are thought to resolve is simultaneity of local-global constructs (Sahay et al., 2013). Local processes and practices can be implemented in multiple sites through the affordances realised by the existence of large scale global IIs.

This essay focuses on a specific kind of II, “research infrastructures”. The European Commission (2024) defines “research infrastructures” as *“facilities that provide resources and services for the research communities to conduct research and foster innovation in their fields. These include*

- *major equipment or sets of instruments*
- *knowledge-related facilities such as collections, archives or scientific data infrastructures*
- *computing systems*

- *communication networks*”.

Moving beyond this technical orientation, Anderson (2013) restates arguments similar to those already constructed for IIs, i.e., that research infrastructures evolve over time through processes of growth and stabilisation and that their conceptual definition can be located in the concepts of networks and systems, “systems that incorporate the needs of people, organisations, social, and economic factors” (p. 7). Several echoes of the defining characteristics of IIs are mentioned by Anderson when attempting to understand RIs, including that they: are incorporated into an already built environment; have spatial and temporal reach; are intrinsically part of a community of practice helping to shape those practices and members’ sensemaking; are invisible unless they break down. Anderson also emphasises understanding RIs within a cultural-historic context, i.e., the “long view of infrastructure” (cf. Jackson et al., 2007). She also introduces another dialectical relational element that underpins RIs, e.g., that they are both material/physical and digital/virtual. These concepts may co-exist where research infrastructures have a digital dimension or they may refer to separate parts of an extensive RI. The main difference between generic IIs and RIs lies in the communities of practice that they serve, i.e., researchers in various disciplinary fields, and what constitutes the key sharing component of the network, which appears to be “knowledge” in addition to information and data.

Infrastructuring and networks of action

Infrastructuring is defined as “the ongoing and continual processes of creating and enacting information infrastructures” (Karasti & Blomberg, 2018). The definition embraces an understanding that infrastructures are continually emerging and becoming through everyday practices, therefore researching them is more about understanding the processes involved than investigating them in stasis. In keeping with this processual view, infrastructuring is seen to be one of many similar terms suggesting the processual nature of infrastructures, e.g., “growing” (Edwards et al., 2009). Of particular interest to this essay is an emerging understanding of “infrastructuring work” as the processual view of all the activities involved “[in] captur[ing] interventions, actions, and transformations in designing and developing infrastructures” (Aanestad et al., 2014, p. 836) and the corresponding notion of the “work of infrastructuring”, understood to be how the developed infrastructures themselves then impact the organisation of work. This view supports a perspective that infrastructures and the practices they enable mutually shape each other. With respect to RIs, a similar view is suggested, e.g., in Anderson’s (2013, p. 11) observation that “libraries and archives become research infrastructures when their practices are in relationship to the practices of scholarship”.

Also of interest to this essay is the concept of “networks of action” (Braa et al., 2004), which position infrastructuring work in ICT4D (the field of information and communication technologies for development) as proceeding from pockets of action-related research which foster both innovation and standardisation (the dialectic nature of IIs) through networked capability-building. This concept was built on in previous work studying interventions in the LIBSENSE case (Abbott & Wagg, 2023).

Infrastructuring and social justice

Previous research related to infrastructuring and social justice appears to follow two related streams. The first investigates how infrastructures may lead to the maldistribution of access that often results in some communities/groups/nations being deprived of resources that are otherwise available in other contexts/situations. In terms of digital infrastructure this type of phenomenon is often referred to as digital divides (Lythreath et al., 2022) or digital exclusion (Ragnedda, 2018). According to Pawlicka-Deger (2021), “Infrastructure reveals a set of disturbing questions of inclusion/exclusion, connection/disconnection, and scaling up/down in the social configurations”. Focusing on the material aspects of infrastructure may surface mainly “first order” digital divide issues of access to infrastructure while socio-economic and literacy issues may be the more relevant and intractable issues to address (Helsper & Van Deursen, 2015; Van Deursen & Van Dijk, 2014). Research that emphasises these latter issues frame digital divides as “second-order” and “third-order” and therefore more about addressing the socioeconomic and political aspects of infrastructuring rather than its more instrumental ones (Eubanks, 2012). The second stream of work focuses on cognitive justice issues, i.e., the systemic and hegemonic oppression of indigenous knowledge systems by dominant and generally former colonial powers, also referred to as “epistemic violence” (Morris, 2010) and “epistemicide” (Ndlovu-Gatsheni, 2018). This stream of work focuses on how the development of research infrastructures may work against open systems for sharing and disseminating research (Albornoz et al., 2020; Herb & Schöpfel, 2018). Ultimately, those engaging in infrastructuring work cannot assume technological neutrality and need to be conscious of existing power relations and asymmetries which can become inscribed in these networks and systems (Pawlicka-Deger, 2022).

This essay builds on previous work which developed a social justice framework with which to understand how action research interventions in a large African research infrastructure project worked towards reducing injustices that persist in low-resource settings when ICTs are deployed to resolve development issues (Abbott, 2024). The concepts underpinning the framework were drawn from Nancy Fraser’s writings on social justice. Fraser’s social justice lens was used as a basis for that work. Fraser (2005, p. 73) defines social justice as: “parity of participation... justice requires social arrangements that permit all to participate as peers in social life. Overcoming injustice means dismantling institutionalized obstacles that prevent

some people from participating on a par with others, as full partners in social interaction". Fraser (1997, 2005) proposes three analytical dimensions of "injustice": socioeconomic, e.g., being marginalized socially/economically; cultural/symbolic, e.g., being culturally dominated by beliefs, norms etc., from other cultures or being rendered "invisible" or being maligned or disparaged by others; and politically, e.g. concerning how decisions are made about who should be entitled to just actions. She also argues that injustices can be remedied by two types of action, one "affirmative" and the other "transformative". Affirmative remedies are "aimed at correcting inequitable outcomes of social arrangements without disturbing the underlying framework that generates them" (Fraser, 1997, p. 23). These strategies accept that the existing social structures remain in place, while attempting to address them, i.e., the status quo remains (Luckett & Shay, 2020). Transformative remedies, on the other hand, are "aimed at correcting inequitable outcomes precisely by restructuring the underlying generative framework" (Fraser, 1997, p. 23). Such actions would tend to challenge the status quo. The key injustices identified for each dimension of remedy are explained as: maldistribution (socio-economic), where resources are not distributed fairly leading to distributive inequalities; misrecognition (cultural), where people are unable to participate fairly due to systemic bias against their specific cultural characteristics; and misrepresentation (political), where people are denied the opportunity to decide how they can participate in actions that would benefit them (Fraser, 1997, 2005; Hodgkinson-Williams & Trotter, 2018).

From the literature review, the following key themes can be summarised loosely into a framework with which to consider the case study being presented in this essay. To begin with, it can be assumed that developing research infrastructures to address the visibility of African scholarship using open science principles necessitates interventions that could be conceptualised as "infrastructuring work" in this context. For this infrastructuring work to achieve social justice goals, two aspects need to be considered. First, social justice issues related to the maldistribution of resources need to be considered, in this case, this will involve at least first order digital divide concerns such as access to digital technologies that are affordable and fit for purpose. Second, since the case involves applying open science principles to the research lifecycle, the cognitive justice issues related to embedded systemic asymmetries in knowledge production and dissemination need to be addressed. Third, both concerns may be remedied by relevant affirmative and transformative actions. In the case of the maldistribution social justice issues, affirmative actions would involve programmes to provide the physical infrastructures and policies for their use. These actions would not result in changes to the status quo underlying the existence of the maldistribution of resources, but would act within current structures to remedy its effects. Transformative actions, on the other hand, would address the underlying reasons for inequalities in the maldistribution of these resources, such as influencing political or socioeconomic structures.

In the case of cognitive justice issues, affirmative types of actions could ensure the wider distribution of African research through green open access, e.g., the wider uptake of open access repositories. However, more transformative actions would also need to address the political and socioeconomic issues which make this an enduring issue.

Methodology

The methodology adopted in this essay is a form of archival analysis (Das et al., 2018) using a digital archive of documents covering a period of LIBSENSE activity from October 2016 to December 2023. The activities recorded in the archived documents cover several categories: *Research* (Data Analyses; Data Gathering); *Dissemination* (Conferences; Articles/Papers); *Interventions* (Workshops; Webinars; Policy Development) and *Collaboration* (Project Proposals; Partner Events; Partner Projects; Collaboration agreements). The archived documents were coded using a bespoke coding scheme developed purposefully to examine the contribution of the documented interventions to various goals and objectives of the LIBSENSE project. The result of the coding scheme is presented in Table 1 below.

Table 1. Codes Applied to the LIBSENSE Archive of Documents

High-level Codes	High-level Code Description	Low-level codes	Low-level Code Description
Networks	Codes at high level any networks observable in the case study	Networks of actors	Actors involved in networks that accomplish activities in the initiative
		Networked activities	Activities accomplished by networks within the initiative
		Changing composition of networks	Networks not stable and changing according to goals/objectives/interests and so on.
		Actors' interests	Actors expressing interest in being part of the network
Goals	Codes at high level anything that looks like an objective or an aim that has been declared for the case study	Shared goals	Where more than one party shares the same goal
		Changing goals	Where goals seem to change over time

High-level Codes	High-level Code Description	Low-level codes	Low-level Code Description
Open Research	Codes related to activities that promote any of the major themes of open research	Open Science	Where the objectives of the activities are aligned with open science in general
		Open Access	Where the objectives of the activities are aligned with open access in general
		Open Data	where the objectives of the activities are aligned with open data in general
Making African Scholarship Visible	Where any activity, objective aligns with getting African Scholarship to be more discoverable, more visible to international audiences	N/A	N/A
Co-development	Code at high level any activities where co-developing with different groups is happening	Of research infrastructure	Activity involves building a research infrastructure
		Of research policy	Activity involves trying to develop research policy, e.g., open access or open science research policy with others

High-level Codes	High-level Code Description	Low-level codes	Low-level Code Description
Context	Code any activities that give an idea of any challenges or issues that might be happening in the environment surrounding this initiative	Funding	Sourcing funding for the initiative or projects coming out of the initiative
		Librarians' changing profession	Any issues related to librarians changing their skillsets, doing further training, doing capacity building etc.
		Higher education / university senior management	Lack of management support from higher education / universities
		Publishing	Ability or not of scholars to publish, e.g. lack of access to scholarly communications or library databases

Findings

LIBSENSE case study description

LIBSENSE, which is an acronym for “Library Support for Embedding National Research and Education Network (NREN) Services and e-Infrastructure”, has been described simultaneously as an initiative, a project, a network and a grassroots movement. It was conceived as a continent-wide operation to promote open science in Africa as a way to conduct research following “strategies and solutions that work in the African context”. It is mainly funded by AfricaConnect, a large infrastructural program to enable the “last mile” connectivity of African higher education and research institutions through leveraging technological capacity from existing research and education networks in Europe. As part the AfricaConnect programme, research and education network (REN) organizations (at national and regional levels) were instituted in Africa to provide coordinating structures through which network connectivity could be implemented in higher education and research institutions (Harle, 2017). The REN concept was borrowed from Europe and was seen as a potentially successful model in other LMIC contexts (Foley, 2016), in particular, in Eastern/Southern Africa, and was also actively pursued in the West African region.

In 2017, LIBSENSE was officially launched by the West and Central African Research and Education Network (WACREN) in partnership with two NGOs, Electronic Information for Libraries (EIFL) and Confederation of Open Access Repositories (COAR), and the University of Sheffield (UoS) Information School (IFLA, 2021). Given WACREN's remit as the coordinating body for 22 West African countries, their primary interest was in advocating for and providing key infrastructural services such as federated networks, broadband connectivity, high performance computing, and building standards for next generation open access repositories (OARs). They enlisted UoS to help co-develop a research agenda around the adoption of open access/science policies and practices as part of this infrastructuring work. Action research initiatives like LIBSENSE attempt to address the perceived weakness of African research environments and the consequent lack of visibility of African research which leads to social justice inequities and the potential for extractivist research practices (Abbott, 2024). LIBSENSE was addressing these issues through instituting open science principles following well-established practices of other global South initiatives, e.g., the pioneering work done by Scientific Electronic Library Online (SciELO) which operates mainly in Latin America and the Caribbean.

During the third phase of AfricaConnect funding (AfricaConnect3), the infrastructuring work of LIBSENSE was organised around three pillars: 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) (LIBSENSE, 2023). The main activities carried out by network members 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 by interventions from members in the network. After the initial advocacy and awareness-raising work, LIBSENSE began influencing future policy on how openscience would evolve in higher education and research institutions. The timeline of funded LIBSENSE interventions and the organisation of this work can be seen below in Figures 1 to 3.

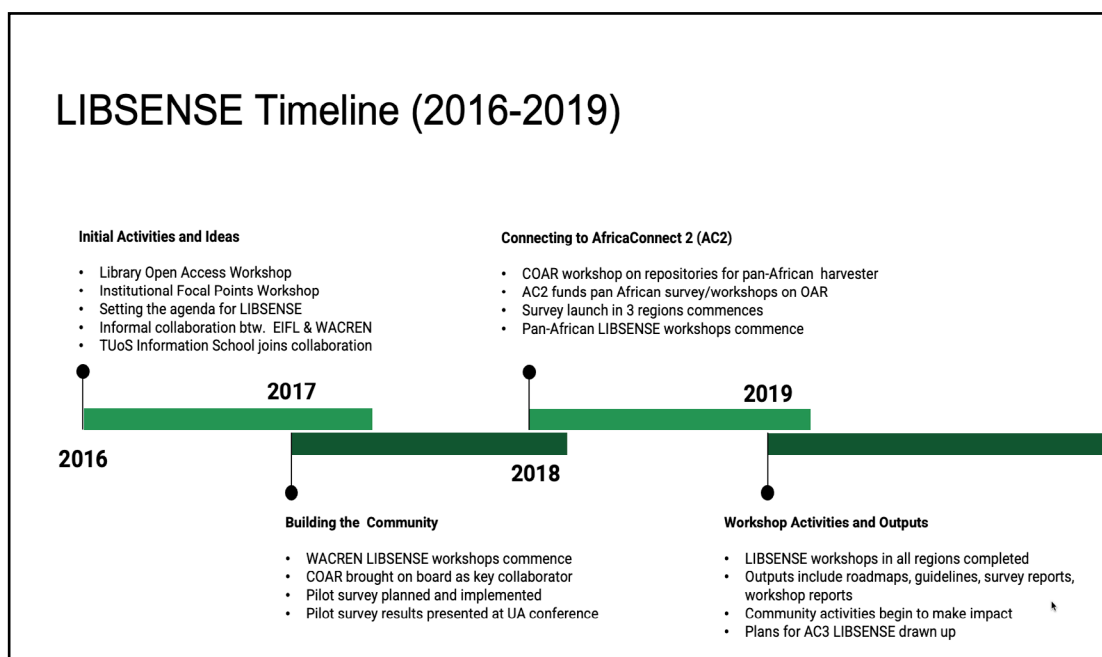


Figure 1. LIBSENSE interventions and activities under AfricaConnect2

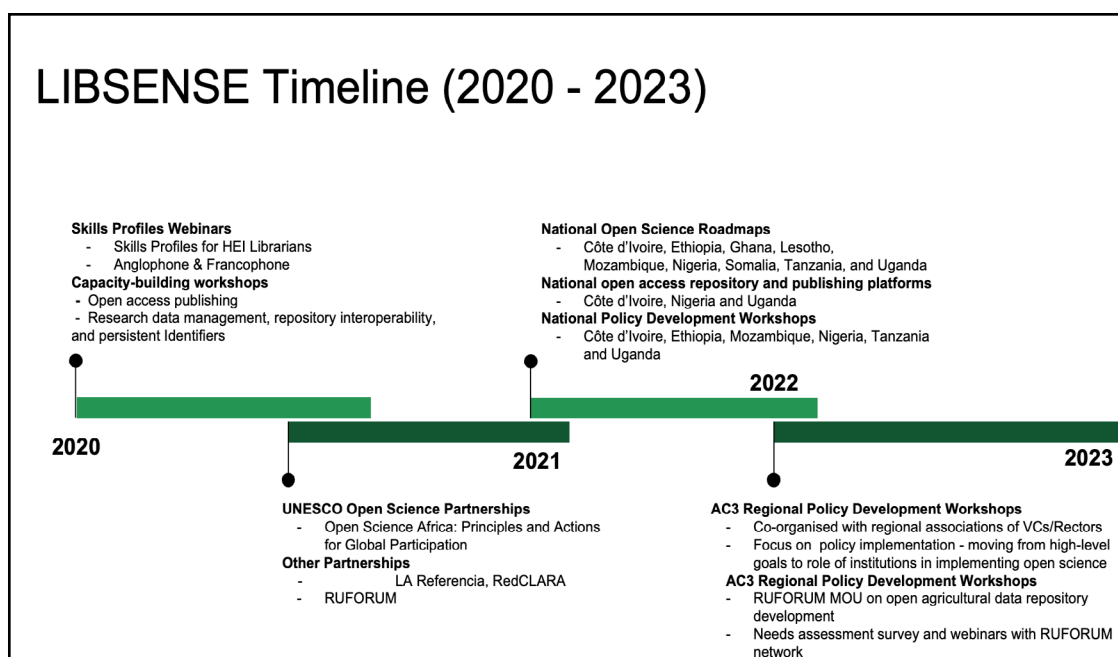


Figure 2. LIBSENSE interventions and activities under AfricaConnect3

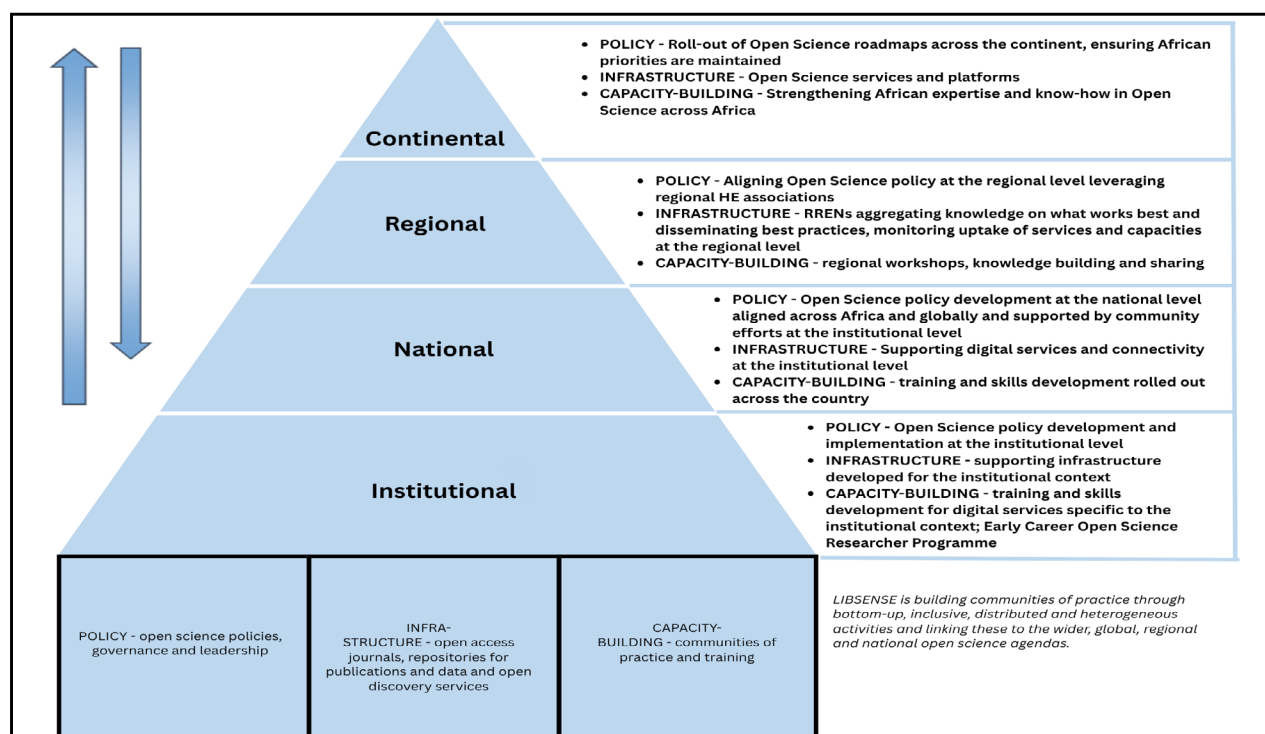


Figure 3. The organisation of LIBSENSE infrastructuring work under 3 pillars

Some selected example interventions of this infrastructuring work are described in the following section

Exploration of selected interventions

Intervention 1: LIBSENSE 3-region survey on Open Access Repository (OAR) development (2018 – 2019).

Description of the intervention

This intervention had two components and its scope was continent-wide. The intervention was instituted in all three geographical regions where there is a regional coordinating REN, i.e., West and Central, East and Southern and Northern Africa. The first component was a survey which was completed by HE librarians and REN representatives in their respective regions. The second component was a follow-on workshop launched in the corresponding region, which was co-hosted at the regional REN organization’s annual conference/meeting.

Objectives of the intervention

This objectives of the intervention were: (1) to develop and implement a vision of African Open Scholarship led by African Librarian Communities of Practice; (2) To establish and understand the drivers for, and the hindrances against, change that would deliver on this promise; (3) to determine “e-readiness”, i.e., the extent to which HEIs were building the necessary resources and capabilities to deliver digital innovations and (4) to determine the evolving role of the African HEI library in light of digitalisation.

Expected outcome of the intervention

A key expected outcome of this intervention was more collaboration between academic libraries and the country-level national RENs in the servicing and management of open access repositories (OARs) in academic libraries. Note that OARs are a primary means of facilitating green open access. This collaboration was expected to provide complementary technical skills to build the librarians' capacity in this area.

Intervention 2: Skills profiles development workshops (2020)

Description of the intervention

This intervention was initiated as a result of the 3-region survey and workshop intervention above, which concluded that there was low capacity around HEI librarians' skillsets for open science practices in general (Abbott et al., 2020). The scope of the workshop was also continental since it included participants from any of the regions served by the 3 regional RENs. The librarians themselves had collectively expressed skills deficits in the more technical aspects of supporting open science initiatives such as metadata development, back-end support of repositories, infrastructure support and other digital skills related to their work. The intervention was delivered as an online webinar, with several online 'streams' designed to cater for particular skills profiles identified as future proficiencies the librarians wanted to learn. Each stream was facilitated and the material co-developed by an African expert in that specific skills profile.

Objectives of the intervention

The aim of these workshops was to discuss the evolving skills profiles of the HEI librarians and to determine a set of preferred skills profiles to support ongoing digitalisation (e.g., OAR development, data analytics, support for Open Science) that suit an African HEI context.

Expected outcome of the intervention

The intervention was expected to engage HEI librarians proactively with the foresight of how their professional roles could develop to cater for the technological advances inherent in supporting open science practices. The skills profiles would provide them with tangible insights into the knowledge, skills and abilities needed to progress into these roles.

Intervention 3: Policy development workshop (2021-2022)

Description of the intervention

This intervention targeted senior university executives who were recognized as key in supporting institutional change and consisted of a workshop with three components. The first was sensitising the workshop attendees to the concepts of research assessment reform through a pre-workshop webinar on the topic (LIBSENSE-DORA, 2022) and a presentation by an expert in the area on the day of the workshop (LIBSENSE, 2021b).

The second was the presentation of a set of case studies created by African open access/science advocates to illustrate how African HEIs had developed/implemented open access/open science policies in their institutions and the subsequent lessons learnt (LIBSENSE, 2021a). The third was an interactive session where the invited senior executives engaged in discussions as to how they could develop similar policies in their institutions and catalyse change in a similar way. The scope of the workshop was both regional, since the participants were mainly from the WACREN region, and institutional, since the policy work was intended to influence that level.

Objectives of the intervention

The inspiration for the workshop stemmed from LIBSENSE aligning with the UNESCO recommendation on Open Science (LIBSENSE Working Group on Open Science policies, 2020). The broad aim was to establish how to move from the high-level goals and principles articulated in the recommendation to how institutions could implement related policies in practice.

Expected outcome of the intervention

The expected outcome was for the senior executives to consider how open science policy development in their own institutions could encourage research assessment reform and consequent potential benefits. For example, they were expected to understand how such reformed practices could free African scholars from the 'publish or perish' imperative of striving inequitably for representation in elite Western journals, which are mostly inaccessible in resource-poor institutions.

Intervention 4: RUFORUM open data sharing platform collaboration (2021 – ongoing)

Description of the intervention

In collaboration with RUFORUM, a pan-African network of agricultural research institutions, LIBSENSE is developing and piloting an agricultural research data repository (*LIBSENSE-RUFORUM – LIBSENSE, 2023*). The scope of this intervention is both continental and regional. Its implementation is intended to take place at the institutional level.

Objectives of the intervention

This intervention seeks to upgrade RUFORUM's Knowledge Repository by providing research infrastructure for Agricultural research data sharing and management, journal hosting and publishing and creation of open educational resources (OER) training material on research data management.

Expected outcome of the intervention

The expected outcome will be a new platform for agricultural open data hosted by RUFORUM with distributed access and stewardship across the RUFORUM membership.

Discussion

The discussion will explore how useful the framework introduced in the Literature Review is in uncovering potential areas in which the action-based interventions of the LIBSENSE project have the potential to either challenge existing systemic inequities or to provide pragmatic but non-transformative solutions to some of the issues identified as hampering the equity in research production and dissemination in the African context.

In the interventions described in the previous section, there is evidence of infrastructuring work that can be interpreted as affirmative. Intervention 1 was aimed at addressing the low implementation and uptake of OARs across Africa, gaps in higher education librarians' capabilities to support OAR development and inconsistent institutional support for OAR development. The intervention's approach was to raise awareness and build communities of practice around OAR development, both of which can be interpreted as affirmative, since they did not seek to address any systemic issues, but to work within the current status quo. The approach to the intervention 2 was to co-develop with leading African HEI librarians knowledgeable in open science practices a set of skills profiles that they believed would provide prospective professional roles to which their peers could aspire if they wanted to meet digitalisation challenges to their profession. To some extent, the action taken was affirmative in that it was seen as a capacity-building, awareness-raising exercise which worked within the existing structures to stimulate change. Intervention 3 sought to address senior HEI executives' assumed lack of sufficient exposure to open science policy implementation and its link to institutional research assessment reform. This was addressed, as in intervention 2, mainly through awareness-raising and introduction to global ideas on research reform through DORA initiatives (LIBSENSE-DORA, 2022), which can be seen as an affirmative action. The premise of intervention 4 was the technology obsolescence of RUFORUM's existing knowledge repository. The choice of an open science infrastructure solution in the form of an open data repository represents a step change for the RUFORUM secretariat bringing with it the need for significant capacity-building. The infrastructure re-development and capacity building efforts represent affirmative actions leading to addressing access, readiness and open data literacy issues.

The interventions also demonstrated efforts at bringing about transformative results through some of the actions taken, albeit in subtle ways. The 3-region survey and workshop approach of intervention 1 brought together communities of practice that did not 'talk to each other' previously. HEI librarians and REN representatives, each with their own professional

remits and expertise were brought into conversation with each other, bringing perspectives as to how to address the OAR problem. Though minor, this kind of intervention had the capability of transforming approaches to open science provision in a more collaborative way than had been conceived of before. It would address a systemic issue around HEI librarians' access and exposure to the technological aspects of implementing open science solutions while at the same time exposing REN representatives to the actual potential impacts of providing REN services. Intervention 2, following on from intervention 1 had the capacity to embed this systemic change to thinking. It created a 'future vision' of what the African HEI librarian professional could aspire to. This intervention challenged the status quo and demonstrated how capacity building could be achieved through leveraging the power of the LIBSENSE network's own expertise. Since the workshops were held online, their transformative potential was amplified by their greater (virtual) reach. Cognitive injustice issues are assumed to underpin issues face by African scholarship in the Western-dominated scholarly communications system. To address this, the intervention 3 workshops promoted policy change to propagate open science initiatives at the institutional level which would change not just the system of publishing African academic outputs but also the incentive structures through which academics gained institutional recognition and reward (i.e., promotion/tenure). This type of action would be considered transformative since it is agenda-setting and challenging the status quo. With intervention 4, the action of codeveloping of the new platform with RUFORUM actors has been critical to its current progress. This attests to a transformative, co-creation approach, incorporating beneficiaries' views into decision-making about the infrastructure design as it progresses. RUFORUM members are thus empowered to direct the development of the repository to assure their sovereignty over their datasets. This approach thus counters existing structures of decision-making by evolving a new approach as the repository is developed.

Some key implications can thus be drawn from the case study. The infrastructuring work taking place comprises *shared goals and objectives of a network of actors*. These goals depend 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. This demonstrates affirmative and potentially transformative networks of action throughout the LIBSENSE project's lifetime. Although subject to change, these goals broadly encompass the open science agenda espoused by the project and notions of cognitive justice related to enhancing the global visibility of African scholarship. The *co-development of research infrastructure*, i.e., the building of physical and digital infrastructure on which services can be mobilized themselves shape the research environment, e.g. the RUFORUM open data collaborative project. This represents the 'work of infrastructuring' which begins to build further outcomes on what the project initially achieves thus leading to potential transformative outcomes.

The LIBSENSE 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. There is evidence of these networks of action achieving affirmative outcomes and depending on the action, potentially transformative ones. 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 (digitalisation effects, e.g.), publishing (industry, access etc.). Both affirmative and transformative actions are challenged by such an environment and may struggle to achieve long-lasting change.

Conclusion

This essay presented initially a persistent issue of lack of visibility of African scholarship with which the academic community is wrestling on an ongoing basis. It posited that applying open science principles could be a potential solution, but that this required robust research infrastructures. The essay subsequently presented some concepts around how such infrastructuring work could be achieved in an African context and it analysed the work currently underway through one such project, LIBSENSE, a REN-based initiative. The analysis of the project using the framework inspired by literature on infrastructuring and social justice reveals the potential for change but with the caveat that such change may be temporary and may also not be able to address the more systemic issues adequately. More has to be done to examine underlying systemic biases at regional, national and global levels to start to conceive programmes and initiatives that can offer more sustainable solutions.

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